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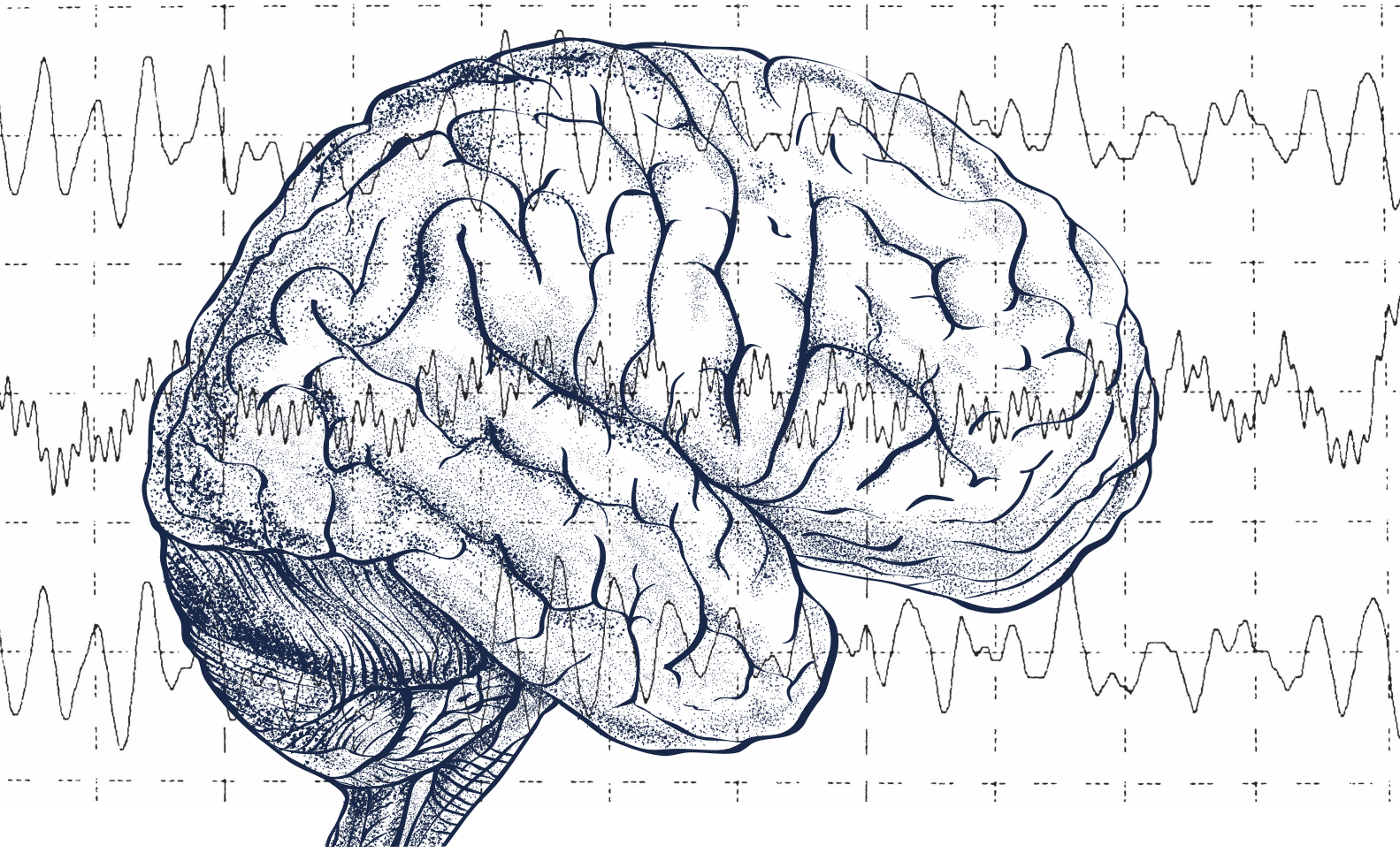

35th Annual
Meeting of the
Associated
Professional Sleep
Societies

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Welcome to your preview of SLEEP 2021, the 35th Annual Meeting of the Associated Professional Sleep Societies, which is scheduled to be held virtually on June 10–13, 2021.

This abstract supplement unites the journal *SLEEP* and the science of SLEEP 2021. All abstracts presented at SLEEP 2021 are included in this special issue. This year 863 abstracts will be presented at the meeting: 120 will be presented in an oral presentation format and the remainder will be presented in a poster format. Many authors of oral presentations will also be presenting their science in the virtual poster hall, providing additional time to network with the authors of these important studies. In addition, this abstract supplement contains case reports submitted by individuals in Sleep Medicine Fellowship and other training programs.

Abstracts in this supplement are divided between Basic and Translational Sleep Science, and Clinical Sleep Science and Practice and then assigned to one of 28 subcategories. Each abstract has a unique four-digit number to facilitate identification and location both within this issue and at SLEEP 2021. The four-digit number in the abstract supplement matches the four-digit code published in the SLEEP 2021 Mobile App.

The SLEEP meeting fosters an environment in which members and attendees learn about the latest basic, translational, and clinical science and technologies, promoting the continued growth of the field through the dissemination of new knowledge. This will be second year that SLEEP is a virtual meeting, and lessons learned in 2020 will help enrich the experience for virtual attendees this year. We hope you stay healthy and look forward to gathering as a community in 2022.

Ronald Szymusiak, PhD
Editor-in-Chief

001

EXPLORING THE OREXIN-TTA/TETO-DTA MOUSE AS A MODEL FOR PEDIATRIC NARCOLEPSY

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Introduction: Narcolepsy is a sleep disorder caused by selective death of the orexin neurons that often begins in childhood. Orexin neuron loss disinhibits REM sleep during the active period and produces cataplexy, an abnormal behavioral state between REM sleep and wakefulness. Cataplexy is often more severe when narcolepsy develops in children compared to adults, but the mechanisms underlying this difference remain unknown.
Methods: We used orexin-tTA/TetO-DTA mice to model narcolepsy at different ages. When doxycycline is removed from the diet, the orexin neurons of these mice express diphtheria toxin A and die within 2–3 weeks. We removed doxycycline at 4 weeks (young-onset) or 14 weeks (adult-onset) of age in male and female mice. We implanted EEG and EMG electrodes for sleep recordings one week later and then recorded EEG/EMG/video for 24h at 3 and 13 weeks after removal of doxycycline. Age-matched controls had access to doxycycline diet for the entire experiment.
Results: Three weeks after doxycycline removal, both young-onset and adult-onset mice developed cataplexy and the sleep-wake fragmentation characteristic of narcolepsy. Age of orexin cell loss did not significantly affect cataplexy severity, however, female mice had more cataplexy than male mice overall. Both young- and adult-onset mice showed a 99% loss of orexin neurons at 3 weeks.
Conclusion: Considered together, our results suggest that the orexin-tTA/TetO-DTA mouse model of narcolepsy does not capture the severe cataplexy that is often seen in the human pediatric population.
Support (if any):

002

DARIDOREXANT, A DUAL OREXIN RECEPTOR ANTAGONIST, IMPROVES AGE-RELATED INSOMNIA IN RATS

Catherine Roch,[1] Cédric Fischer,[2] Francois Jenck,[3] Michel Steiner[1]
[1]Idorsia Pharmaceuticals Ltd., [2]Former employee of Idorsia Pharmaceuticals Ltd., [3]Former employee of Idorsia Pharmaceuticals Ltd

Introduction: Sleep disturbances develop with age, and prevalence of insomnia is higher in the elderly. Daridorexant is a new medication in development for the treatment of insomnia. Our aim was to investigate whether an insomnia-like phenotype develops in old rats, and then to assess the effect of repeated administration of daridorexant in these animals.
Methods: We recorded the electroencephalogram and electromyogram of freely moving male Wistar rats implanted with telemetry transmitters. Time spent sleeping during the inactive phase was measured at the ages of 4 (n=50), 6 (n=55), 8 (n=37), 12 (n=44), 18 (n=22) and 24 (n=9) months. The age at which the rats' time spent sleeping started to be significantly reduced compared to that of 4-month-old rats was when the insomnia-like phenotype would start to occur. The impact of 100 mg/kg daridorexant, given orally at the beginning of the inactive phase, was evaluated in 16-month-old rats (n=8). Rats were consecutively treated daily for 6 days with vehicle (baseline period), for 3 weeks with daridorexant, and again for 1 week with vehicle (wash-out period).
Results: The total time spent sleeping during the 12-h inactive period decreased from 51.3±1.1% (mean ± SEM) at 4-months old to 39.3±4.4% at 24-months, with a significant decrease starting from 8-months ($p<0.05$). Whereas the time spent in rapid-eye-movement (REM) sleep (~10%) was not affected by age ($p=0.64$), the time spent in non-REM sleep decreased from 41.7±0.8% at 4 months to 28.7±3.2% at 24 months ($p<0.001$). In 16-month-old rats daridorexant increased the time spent in non-REM sleep over the first 6-h following administration ($p<0.001$). The time spent in REM sleep was unaffected ($p=0.47$). The average time spent in non-REM sleep over those 6h was 37.2±2.5% at baseline, and 43.8±2.4%, 44.6±2.7% and 44.5±3.0% in the 1st ($p<0.05$ vs baseline), 2nd ($p<0.001$) and 3rd ($p<0.01$) week of treatment, respectively. During the wash-out period, the non-REM sleep time returned to baseline levels (35.6±2.7%; $p=0.06$).
Conclusion: In rats, an insomnia-like phenotype, characterized by reduced non-REM sleep time, develops with age. Daridorexant improves this phenotype and its effect is maintained upon repeated administration over three weeks.
Support (if any): Funded by Idorsia Pharmaceuticals Ltd

003

TREATMENT OF SLEEP DISORDERED BREATHING WITH LEPTIN LOADED EXOSOMES

Carla Freire,[1] Huy Pho,[1] Jacob Ramsey,[2] Stone Streeter,[1] Ryo Kojima,[2] Slava Berger,[3] Thomaz Fleury-Curado,[1] Marina Sokolsky,[2] Elena Batrakova,[2] Alexander Kabanov,[2] Vsevolod Polotsky[1]
[1]Johns Hopkins University, [2]University of North Carolina, [3]Israel Institute of Technology

Introduction: Obstructive sleep apnea (OSA) is characterized by recurrent periods of upper airway obstruction. The prevalence of OSA exceeds 50% in obese individuals and in 10–20% of obese patients OSA coexists with obesity hypoventilation syndrome (OHS) defined as daytime hypercapnia and hypoventilation during sleep attributed to the depressed control of breathing. There is no effective pharmacotherapy for OSA and OHS. Leptin is a potent respiratory stimulant and a potential therapeutic candidate. However, diet-induced obesity (DIO) results in reduced permeability of the blood-brain barrier (BBB) for leptin. Previous studies have shown that the BBB can be penetrated by exosomes, natural nanoparticles that can be used as drug delivery vehicles. In this study, we aimed to determine if exosomes overcome the BBB and treat OSA and OHS in DIO mice.
Methods: o examine the ability of exosomes to cross the BBB, male, lean (n=5) and DIO (n=5) C57BL/6J mice were injected with fluorescent exosomes or saline into the lateral tail vein. After 4h fluorescent exosomes biodistribution was evaluated by an in vitro imaging system (IVIS). Saline injected mice images were used for background adjustment. A separate subgroup of male, DIO (n=10) and lean (n=10) mice were headmounted with EEG and nuchal EMG leads. Sleep studies were performed in a plethysmography chamber and mice received saline, empty exosomes, free leptin, or leptin-loaded exosomes in a crossover manner.
Results: Exosomes were successfully delivered to the brain and the transport across the BBB was more efficient in DIO mice with 2-times greater relative fluorescence units measured in DIO when compared to lean mice ($p<0.005$). In DIO mice, exosomal leptin induced dramatic 1.7-2.2-fold increases in minute ventilation and 1.5-2.0-fold increases in maximal inspiratory flow during both flow-limited (upper airway/sleep apnea) and non-flow limited breathing (control of breathing)

($p<0.05$). In contrast, free leptin had no effect. Lean mice did not present significant sleep disordered breathing and no differences were observed between groups.
Conclusion: We demonstrated that exosomes overcome the BBB and that leptin-loaded exosomes treat OSA and OHS in DIO mice.
Support (if any): R01HL 128970, R01HL 138932, R61 HL156240, U18 DA052301, FAPESP 2018/08758-3

004

SAMELISANT (SUVN-G3031), DIFFERENTIATING FEATURES OVER CURRENT TREATMENTS OF NARCOLEPSY

Anil Shinde,[1] Ramkumar Subramanian,[1] Raghava Palacharla,[1] Vijay Benade,[1] Renny Abraham,[1] Venkatesh Kamuju,[1] Santosh Pandey,[1] Rajesh Badange,[1] Pramod Kumar Achanta,[1] Ramakrishna Nirogi[1]
[1]Suven Life Sciences Ltd

Introduction: Majority of pharmacological agents used in the treatment of narcolepsy have several limitations. Both nonclinical and clinical evidences suggest usefulness of the histamine H3 receptor (H3R) inverse agonists for the treatment of narcolepsy addressing several of the current limitations.
Methods: Extensive nonclinical studies were carried out for Samelisant (SUVN-G3031) and other pharmacological agents that are currently being used for the treatment of narcolepsy. The nonclinical parameters like inter-species binding affinity, selectivity profile, in vivo and in vitro ADME features, nonclinical efficacy, neurochemistry and safety were compared.
Results: Samelisant has no inter-species variation in binding affinity at H3R with less than 50% inhibition at 1 µM against 70 other targets. Unlike pitolisant, Samelisant has no significant binding affinity at sigma 1 and 2 receptor. Samelisant has no inhibition and induction liability towards major CYP enzymes and transporters. Pitolisant is reported to be a CYP3A4, CYP2B6, and CYP1A2 inducer and a CYP2D6 and OCT1 inhibitor. Samelisant has robust wake promoting effects. Samelisant showed negligible affinity towards hERG channel with IC50 > 10 µM and had no effects on heart rate or ECG parameters in dog telemetry study. Samelisant did not show convulsion in rats up to the tested dose of 100 mg/kg, p.o. Most of the pharmacological agents used for the treatment of narcolepsy have abuse liability; Samelisant produced no change in the striatal and accumbal dopamine levels in rats suggesting no propensity to induce abuse liability. Unlike competing H3R inverse agonists, Samelisant has no effects on fertility and embryo-fetal development up to the highest tested doses.
Conclusion: Nonclinical studies demonstrated superiority of Samelisant over pharmacological agents used in the treatment of narcolepsy. Samelisant is currently being evaluated in a Phase 2 study as monotherapy for the treatment of narcolepsy with and without cataplexy (ClinicalTrials.gov Identifier: NCT04072380).
Support (if any):

005

SAMELISANT (SUVN-G3031), A HISTAMINE H3 RECEPTOR INVERSE AGONIST IN ANIMAL MODELS OF SLEEP DISORDERS

Saivishal Daripelli,[1] Parusharamulu Molgara,[1] Nageswararao Muddana,[1] Pradeep Jayarajan,[1] Venkat Reddy Mekala,[1] Veena Reballi,[1] Pramod Kumar Achanta,[1] Ramakrishna Nirogi[1]
[1]Suven Life Sciences Ltd

Introduction: Narcolepsy is a chronic sleep disorder characterized by overwhelming daytime drowsiness, sudden attacks of sleep and sometimes accompanied by cataplexy. Although the orexin deficiency is considered to be the primary cause of this disorder, lot of attention has been diverted on targeting histaminergic neurotransmission by blockade of histamine H3 receptor (H3R). Samelisant (SUVN-G3031) is one of the potent and selective H3R inverse agonist currently being evaluated in a Phase 2 study as monotherapy for the treatment of narcolepsy with and without cataplexy (ClinicalTrials.gov Identifier: NCT04072380). In the current research work, Samelisant was evaluated for neurotransmitter changes in rats and sleep EEG in orexin knockout mice, a reliable proof-of-concept study for treatment of excessive daytime sleepiness and cataplexy in narcolepsy.
Methods: Binding affinity of Samelisant towards human and rat histamine H3R was evaluated in in-vitro radioligand binding assay and functionality in GTP□S assay. Effect of Samelisant was studied in (R)-α-methyl histamine induced dipsogenia. In rat brain microdialysis, Samelisant was evaluated for its effects on modulation of neurotransmitters like histamine, dopamine and norepinephrine. Male orexin knockout mice were implanted with telemetric device for simultaneous monitoring of electroencephalography (EEG) and electromyography. Effects of Samelisant (3 and 10 mg/kg, p.o.) were evaluated during active period of animals.
Results: Samelisant is an inverse agonist at histamine H3 receptors with hKi of 8.7 nM and showed minimal binding against over 70 target sites. Samelisant produced significant increase in histamine, dopamine and norepinephrine levels in cortex. Samelisant produced no change in the striatal and accumbal dopamine levels in rats, suggesting no propensity to induce abuse liability. Samelisant blocked R-α-methyl histamine induced water intake and produced dose dependent increase in tele-methylhistamine levels in various brain regions and in cerebrospinal fluid of male Wistar rats. Samelisant produced significant increase in wakefulness with concomitant decrease in non-rapid eye movement sleep in orexin knockout mice. Samelisant also significantly decreased number of cataplectic episodes in orexin knockout mice.
Conclusion: Samelisant is an inverse agonist at histamine H3 receptor and results from the preclinical studies presented here provide a strong evidence for the potential utility of Samelisant in the treatment of narcolepsy with and without cataplexy.
Support (if any):

006

THE EFFECT OF SODIUM OXYBATE ON CATAPLEXY IN OREXIN KNOCKOUT MICE

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[1]University of Toronto

Introduction: Narcolepsy is a neurological disorder that is characterized by the loss of orexin neurons in the lateral hypothalamus. Cataplexy is a symptom of narcolepsy and is identified by a sudden loss of muscle tone during wakefulness. Cataplexy abruptly interrupts day-to-day activities, and makes activities like driving dangerous and potentially fatal. It is hypothesized that cataplexy occurs due to the intrusion of REM sleep muscle atonia during wakefulness. It has been demonstrated that a GABAergic mechanism is responsible for silencing the REM sleep atonia circuit and preventing REM sleep muscle atonia from occurring during wakefulness. Sodium oxybate (SXB), a low affinity agonist of GABAB receptors, is currently an approved treatment for narcolepsy; however, its mechanism of action in the brain remains unknown. Here, we investigate the hypothesis that SXB prevents cataplexy through a GABAB mediated mechanism by potentially suppressing the REM sleep atonia circuit.

Methods: We intraperitoneally (IP) injected orexin-/- mice with one of five treatments; either Lactated Ringers Solution, SXB at 50, 100, or 200 mg/kg, or Phaclophen at 10 mg/kg followed by SXB at 100 mg/kg. Cataplexy was assessed by video recordings. We gathered and analyzed data at three distinct chronological time points (i.e, at baseline, after three consecutive weeks of daily dosing with a treatment, and after one week of no treatment). These experiments were designed and conducted to determine whether; 1) SXB reduces cataplexy, 2) the cessation of SXB administration has an effect on cataplexy, 3) SXB is mediated through a GABAB mechanism.
Results: We first confirmed that mice used were indeed orexin-/- using immunohistochemical analysis to show that no orexin-a expressing neurons were located in the lateral hypothalamus. Then, we determined that: 1) SXB reduces cataplexy compared to time matched controls (unpaired t-test, p=0.0027, n=18); 2) When we stopped administering SXB IP injections, cataplexy levels increased towards control levels (paired t-test, p=0.0024, n=18); 3) it remains unclear if SXB's effect is solely mediated through a GABAB mechanism.
Conclusion: Our findings demonstrate that SXB effectively reduces cataplexy in orexin-/- mice.
Support (if any): This research was funded by Jazz Pharmaceuticals

007

NLRP3 INFLAMMASOMES CONTRIBUTE TO DYSREGULATED SLEEP AND ELECTROENCEPHALOGRAM DELTA POWER AFTER MILD AND MODERATE TBI IN MICE

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[1]VA Boston Healthcare System & Harvard Medical School, [2]VA Boston Healthcare System, [3]VA Boston Healthcare System, Harvard Medical School, Boston University

Introduction: Most traumatic brain injuries (TBI) are mild to moderate and can cause persistent dysregulated sleep, although the mechanisms are not well understood. Interleukin-1 beta (IL-1β) is a pro-inflammatory molecule that is activated in the cortex after waking activity and pathogenic challenge and alters non-rapid eye movement (NREM) sleep and electroencephalogram (EEG) delta power. Nucleotide-binding domain leucine rich family pyrin containing 3 (NLRP3) inflammasomes sense changes in their local environment to stimulate caspase-1 to activate IL-1β into its mature form. We previously found that NLRP3 inflammasomes are increased in the cortex after acute sleep loss and contribute to increased NREM sleep and EEG delta power after sleep loss and toxin challenge. We aimed to determine if NLRP3 inflammasomes contribute to the persistent dysregulated sleep caused by TBI.
Methods: Using 2-3-month-old mice lacking NLRP3 and C57BL/6J wild-type control mice, we assessed sleep states and sleep state episode durations and frequencies prior to TBI, and 24 h, 2-weeks, and 2 months after mild or moderate TBI using polysomnography. TBI occurred in the frontal cortex from a controlled cortical impact device. Additional mice received identical treatments serving as a TBI procedural control but received a craniectomy without the TBI.
Results: Similar sleep findings were observed between the craniectomy control group and baseline measures. However, when compared to baseline values, mice lacking NLRP3 had attenuations in the significant increased amounts of NREM sleep and EEG delta power occurring 24 h after TBI and the significant reductions in NREM sleep and EEG delta power seen 2 months after TBI that were observed in wild-type mice. These effects were similar in moderate and mild TBI groups. Mice lacking NLRP3 were not found to exhibit the fragmented sleep after mild or moderate TBI that was found to persist from 24 h to 2 months post-TBI in the wild-type mice. These effects were evident by significant increased frequencies of waking episodes induced by the TBIs.
Conclusion: Our findings suggest that NLRP3 inflammasomes contribute to dysregulated sleep occurring acutely or more persistently after TBI.
Support (if any): Career Development Award IBX002823 (MZ) and Merit Review Award I01RX001144 (GK) from the United States Department of Veterans Affairs

008

ARC GENOTYPE MODULATES SLOW WAVE SLEEP FOLLOWING TOTAL SLEEP DEPRIVATION

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[1]Washington State University, [2]Elson S. Floyd College of Medicine, Washington State University Spokane, [3]Sleep and Performance Research Center, Washington State University, Spokane, WA

Introduction: The activity-regulated cytoskeleton associated protein (ARC) gene is an immediate early gene that is involved in synaptic plasticity. Recent evidence from a rodent model suggests that Arc may also be involved in sleep homeostasis. However, little is known about the molecular mechanisms regulating the sleep homeostat. In humans, sleep homeostasis is manifested by a marked increase in slow wave sleep (SWS) following acute total sleep deprivation (TSD). There are large, trait individual differences in the magnitude of this SWS rebound effect. We sought to determine whether a single nucleotide polymorphism (SNP) of the ARC gene is associated with individual differences in SWS rebound following TSD.
Methods: 64 healthy normal sleepers (ages 27.2 ± 4.8y; 32 females) participated in one of two in-laboratory TSD studies. In each study, subjects had a baseline day with 10h sleep opportunity (TIB 22:00–08:00) which was followed by 38h TSD. The studies concluded with 10h recovery sleep opportunity (TIB 22:00–08:00). Baseline and recovery sleep were recorded polysomnographically and scored visually by a trained technician. Genomic DNA was extracted from whole blood. The ARC c.*742 + 58C>T non-coding SNP, rs35900184, was assayed using real-time PCR. Heterozygotes and T/T homozygotes were combined for analysis. The genotype effect on time in SWS was assessed using mixed-effects ANOVA with fixed effects for ARC genotype (C/C vs. T carriers), night (baseline vs. recovery), and their interaction, controlling for study.
Results: The genotype distribution in this sample – C/C: 41; C/T: 17; T/T: 6 – did not vary significantly from Hardy-Weinberg equilibrium. There was a significant interaction between ARC genotype and night ($F_{1,62}=7.27$, $p=0.009$). Following TSD, T allele carriers exhibited 47.6min more SWS compared to baseline, whereas C/C homozygotes exhibited 62.3min more SWS compared to baseline. There was no significant difference in SWS between genotypes at baseline ($F_{1,61}=0.69$, $p=0.41$).
Conclusion: ARC T allele carriers exhibited an attenuated SWS rebound following TSD compared to those homozygous for the C allele. This suggests that the ARC SNP is associated with trait individual differences related to sleep homeostasis, and may thus influence molecular mechanisms involved in long-term memory.
Support (if any): ONR N00014-13-1-0302, NIH R21CA167691, and USAMRDC W81XWH-18-1-0100.

009

SELF-REPORTED SLEEP EFFICIENCY AND DURATION ARE ASSOCIATED WITH SYSTEMIC BIOENERGETIC FUNCTION IN COMMUNITY-DWELLING ADULTS

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Introduction: Sleep is important for aging, health, and disease, but its cellular role in these outcomes is poorly understood. Basic research suggests that disturbed and insufficient sleep impair mitochondrial bioenergetics, which is involved in numerous aging-related chronic conditions. However, the relationship between sleep and bioenergetics has not been examined in humans. We examined associations of self-reported sleep with systemic bioenergetic function in peripheral blood mononuclear cells (PBMCs) of community-dwelling adults.
Methods: N = 43 adults (79% female) ages 48–70 (M = 61.63, SD = 5.99) completed the Pittsburgh Sleep Quality Index (PSQI) from which key components of sleep (satisfaction, alertness, timing, efficiency, and duration) were calculated. Participants provided blood samples from which PBMCs were isolated and measured for bioenergetics using extracellular flux analysis. Associations of sleep components with bioenergetic parameters, including the Bioenergetic Health Index (BHI), were examined.
Results: In bivariate analyses, lower sleep efficiency was associated with lower maximal respiration, spare capacity, and BHI ($ps < 0.05$). Longer sleep duration was associated with lower BHI ($p < 0.01$) and later sleep timing was associated with higher basal respiration, ATP-linked respiration, maximal respiration, spare capacity, and non-mitochondrial respiration ($ps < 0.05$). After adjustment for age, sex, and body mass index, lower sleep efficiency ($\beta = 0.52$, $p < 0.01$) and longer sleep duration ($\beta = -0.43$, $p < 0.01$) were associated with lower BHI.
Conclusion: Self-reported indices of sleep efficiency and duration are related to systemic bioenergetic function in humans, suggesting a possible cellular pathway linking sleep to health.
Support (if any): T32HL082610

010

ASSOCIATION BETWEEN OBJECTIVE SLEEP DURATION AND DNA METHYLATION IN ADOLESCENTS

Michael Larsen,[1] Fan He,[1] Yuka Imamura,[1] Arthur Berg,[1] Alexandros Vgontzas,[1] Duanping Liao,[1] Edward Bixler,[1] Philip Gehrman,[2] Julio Fernandez-Mendoza[1]
[1]Pennsylvania State University, College of Medicine, [2]Department of Psychiatry, Perelman School of Medicine of the University of Pennsylvania

Introduction: Insufficient sleep and circadian misalignment are highly prevalent in adolescents and have been associated with physical and mental health disorders. Several genome wide association studies (GWAS) in adults have identified genes that may be involved in the regulation of sleep and circadian traits. However, little is known regarding the epigenetic basis and significance of short sleep duration in adolescence, a critical developmental period.
Methods: To investigate the association between objective sleep duration, as measured by 9-hour in-lab polysomnography (PSG), and DNA methylation in GWAS-informed sleep-related genes, data from 263 adolescents of the Penn State Child Cohort (12-23y, 55.9% male, 23.2% racial/ethnic minorities) were analyzed. Using DNA extracted from peripheral leukocytes, epigenome-wide and GWAS-informed single nucleotide resolution of DNA methylation in cytosine-phosphate-guanine (CpG) sites and surrounding regions were obtained. Multivariable-adjusted linear regression models assessed the association between PSG sleep duration and site-specific methylation levels. Covariates in these models included sex, age, race/ethnicity, body mass index percentile, and psychoactive medication use (i.e., stimulants, anti-depressants, anxiolytics, sedatives, and/or anti-psychotics). P-values were adjusted using the Benjamini & Hochberg method to correct for false discovery rate and, thus, q-values are reported.
Results: PSG sleep duration was associated with differential methylation at 162 intragenic sites in the epigenome-wide analysis with a $q<0.05$. In GWAS-informed analysis, five genes were associated with altered DNA methylation, by which shorter PSG sleep duration was associated with hypermethylation in MAD1L1 ($q=0.02$), MAP2K1 ($q=0.03$), and RBM19 ($q=0.01$) and with hypomethylation in Brain Enriched Guanylate Kinase Associated (BEGAIN; $q=0.0005$) and SLC39A8 ($q=0.02$).

Conclusion: Objective sleep duration in adolescents is associated with altered DNA methylation in genes previously identified in adult GWAS of sleep and circadian traits. Importantly, our data also provides evidence for a potential epigenetic link between objective short sleep duration and genes involved in postsynaptic density (BEGAIN), circadian regulation (MAP2K1/RBM19) as well as internalizing (MAD1L1) and psychotic (SLC38A8) disorders.

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011

SHIFTWORK, FUNCTIONAL BOWEL SYMPTOMS AND THE MICROBIOME

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Introduction: There are about 15 million Americans working full-time on evening, night, or rotating shifts. Between 48% and 81.9% of those working rotating or night shifts report abdominal pain, constipation, diarrhea and other symptoms of functional bowel disorders. The basis for this high prevalence of functional bowel disorders, including irritable bowel syndrome (IBS), among shift workers is unknown. Animal studies, however, suggest that circadian disruption, similar to that in shift workers, may contribute to the development of GI complaints among shift workers by altering the composition and normal diurnal rhythmicity of the resident intestinal microbes.
Methods: Fifty-one full time staff nurses who worked either 12-hour day or night shifts completed demographic information, the Rome III IBS module, daily symptoms diaries for 14 days. They also collected two samples of gut microbiota before the beginning and at the end of their last work shift on day 14, using validated field-tested methods consistent with the Human Microbiome Project. After DNA extraction, 16S rRNA sequencing and assignment to the genus level was completed, samples were then compared to determine if there were 1) differences in the diversity and profile of the microbiome by shift type; 2) if there were differences in the microbiome by time of day for collection; and 3) whether there were differences in the diversity and profile of the microbiome of nurses with IBS and those without IBS.
Results: There were no differences in alpha or beta diversity of gut microbiota when specimens from day and night shift nurses were compared. There were however marginal differences in beta diversity when specimens collected at the beginning and end of the shifts were compared, with seven OTUs being differentially abundant when collected from day shift workers in the evening. There were also three OTUs to be differentially abundant in participants reporting IBS symptoms.
Conclusion: These data did not reveal strong effects of circadian alterations in gut microbiota related to shiftwork. Other factors, such as insufficient sleep and dietary intake during the data-gathering period, need to be explored
Support (if any): Emory University Synergy Grant Program

012

OVERNIGHT LIGHT EXPOSURE ACUTELY INCREASES HEART RATE DURING SLEEP AND DECREASES INSULIN SENSITIVITY THE FOLLOWING DAY

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Introduction: Prior reports indicate that exposure to light at night negatively impacts sleep quality, autonomic and metabolic function, but the interaction between these physiologically interconnected systems is not fully elucidated. We examined the acute effects of nighttime light exposure on sleep macro and microarchitecture, heart rate (HR) and response to oral glucose tolerance test (OGTT), and the relationship between these measures.
Methods: Twenty healthy adults (18 - 40 years) were randomized into Light or Dark groups and run in parallel for a three-day and two-night laboratory stay. The Light group (n=10) slept in the dark (< 3 lux) on Night 1 and slept with overhead room lights on (100 lux) on Night 2, while the Dark group (n=10) slept in the dark (< 3 lux) on both Nights 1 and 2. Overnight polysomnography (PSG) was used to assess sleep macro and microstructure (slow wave activity: SWA: 0.5–4 Hz, and slow oscillatory (SO) activity: 0.5–1 Hz), and beat-to-beat measurement of HR. A two-hour OGTT was completed each morning. The between groups change in PSG-derived measures and metabolic parameters from Night/Day 2 to Night/Day 1, was calculated.
Results: While a greater percentage of time was spent in stage 2 ($p= 0.003$) and a smaller percentage of time was spent in stage 3 ($p= 0.04$), there were no between group differences in SWA and SO activity. Time series analysis of HR changes across the night from Night 1 to Night 2 showed higher HR in the Light vs the Dark group ($p< 0.001$). The change from Day 1 to Day 2 of the initial insulin response (60-min. area under the curve, AUC) showed a higher insulin response in the Light vs the Dark group ($p= 0.029$). The change in HR was positively correlated with the change in the 60-min. AUC of insulin ($R= 0.46$, $p= 0.049$).
Conclusion: A single overnight light exposure acutely increases heart rate during sleep and decreases insulin sensitivity the following day and these responses appear to be associated, suggesting that elevated autonomic activity in response to light at night impacts next day metabolic responses.
Support (if any): Center for Circadian and Sleep Medicine, UL1TR001422

013

ASSOCIATIONS BETWEEN REST-ACTIVITY RHYTHMS AND NOCTURNAL BLOOD PRESSURE ARE SEX-DEPENDENT IN APPARENTLY HEALTHY EMERGING ADULTS

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Introduction: Misalignment between endogenous circadian rhythms and environmental signals – an emerging risk factor for cardiovascular disease (CVD) – can disrupt diurnal blood pressure (BP) rhythms, resulting in higher nocturnal BP and less-pronounced BP dipping (i.e., % decline in nighttime systolic BP [SBP] relative to daytime values). Daily patterns of rest and activity ('rest-activity rhythms' [RAR]) are a proxy for estimating circadian disruption in free-living settings and have been independently associated with elevated CVD risk. However, the relation between RAR and nocturnal BP is unclear. Thus, we aimed to quantify the associations between RAR and nocturnal BP characteristics in male and female emerging adults (18-25y).
Methods: Fifty healthy emerging adults (20±1y; 20M/30F) underwent 24-h ambulatory BP monitoring following 14 consecutive days of continuous wrist actigraphy. RAR variables of interdaily stability (IS; day-to-day consistency in RAR), intradaily variability (IV; within-day fragmentation of RAR), and relative amplitude (RA; difference between trough vs. peak activity) were computed. Bivariate correlations were used to quantify associations between RAR variables and nocturnal BP characteristics for all participants, and separately for males and females. Linear regression models of mean nocturnal SBP, nocturnal diastolic BP (DBP), and SBP dipping were also generated to test main and interactive effects of sex and RAR. Potential confounders (variables associated with outcomes at $p<0.10$) of daytime BP, race, body mass index, physical activity, sleep duration, alcohol, caffeine, and sodium intake were also included as indicated.

Results: Overall, IS and RA positively correlated with % SBP dipping (IS: r=0.33, p=0.02; RA: r=0.35, p=0.01). Among females only, correlations strengthened (IS: r=0.50, p<0.01; RA: r=0.52, p<0.01) and an inverse association between RA and mean nocturnal SBP emerged (r=-0.46, p=0.01). Conversely, among males, no significant associations were apparent. Multivariate regressions revealed a significant sex*RAR interaction, such that in females, every 1-standard deviation increase in IS and RA were associated with an average decrease in nocturnal SBP of 5.4 mmHg (95% CI: -10.0, -0.73) and 4.8 mmHg (95% CI: -9.2, -0.34), respectively.
Conclusion: Findings suggest that consistent and high-amplitude RAR associate with more favorable nocturnal BP characteristics, particularly in emerging female adults.
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014

DIURNAL CHANGES IN PERINEURONAL NETS AND PARVALBUMIN NEURONS IN THE RAT MEDIAL PREFRONTAL CORTEX

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Introduction: Perineuronal nets (PNNs) surrounding fast-spiking, parvalbumin (PV) interneurons provide excitatory:inhibitory balance within cortical circuits. This balance is impaired in several disorders that are also associated with altered diurnal rhythms, yet few studies examined diurnal rhythms of PNNs or PV cells.
Methods: We measured the intensity and number of PV cells and PNNs labeled with Wisteria floribunda agglutinin (WFA) and also the oxidative stress marker 8-oxo-deoxyguanosine (8-oxo-dG) in rat prelimbic medial prefrontal cortex (mPFC) at Zeitgeber times (ZT) ZT0, 6, 12, and 18. To examine changes in inhibitory and excitatory inputs to PV cells, we measured GAD 65/67 and vGLUT1 puncta apposed to PV cells with and without PNNs. Whole-cell slice recordings in fast-spiking (PV) cells with PNNs was conducted to determine the ratio of alpha-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid receptor:N-methyl-D-aspartate receptor (AMPA:NMDA) at ZT18 vs. ZT6. Finally, the number of PV cells and PV/PNN cells containing orthodenticle homeobox 2 (OTX2), which maintains PNNs, was also assessed.
Results: Relative to ZT0, the intensities of PNN and PV labeling were increased in the dark compared with the light phase. The intensity of 8-oxo-dG was decreased from ZT0 at all times. There were more excitatory puncta on PV cells with PNNs at ZT18 vs. ZT6, but no changes in PV cells without PNNs and no changes in inhibitory puncta. There was an increased AMPA:NMDA ratio at ZT18 vs. ZT6. The number of PV cells and PV/PNN cells containing OTX2 showed a strong trend toward an increase from ZT6 to ZT18, with no differences in non-PV-containing cells.
Conclusion: Diurnal fluctuations in PNNs and PV cells alter cortical excitatory:inhibitory balance. Detailed understanding of how these fluctuations are regulated should provide new insights into treatments for diseases impacted by disturbances in sleep and circadian rhythms. Ongoing studies are examining diurnal fluctuations in downstream signaling after PNN removal.
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015

MODULATING MELATONIN DYNAMICS AT TRANSCRIPTION LEVEL USING VIRTUAL KNOCKOUT APPROACHES: AN ADVANCED PERSPECTIVE IN SLEEP MEDICINE

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Introduction: Sleep disorders, the most neglected public-health issues, are threatening overall health. It is tightly associated with the individual's exposures to the light/dark (LD)-cycles linked to their circadian rhythms. Lifestyle, shift-work, frequent travels, and post-pandemic-stress lead unintentional compromise of sleep, thus circadian homeostasis. Melatonin (MT), a pivotal natural hormone for circadian and sleep health, attains acrophase in the dark. MT mediates LD-triggered circadian rhythms through its dynamic expressions. Circadian phases are greatly reflected by MT-dynamics. Dim-light-MT-onsets (DLMO) act as a marker, reporting internal circadian-timing in mammals. Estimating this is essential in therapeutic-designing against misaligned circadian conditions. Despite many experimental approaches, there is still a slit hacking the MT-dynamics from molecules to systems. Inclusive perspectives on endogenous factors affecting MT's synthesis, secretions and bioavailability over time-course are not extensively exposed. MT-dynamics has multiplexed stochastic interactions across numerous genes, TFs, and regulators, and they are coupled non-linearly. Small changes used to compound through the genetic networks and reflected in systems-wide events marking distinct signalling response dynamics. Understanding such responses is challenging yet imperative. A robust quantitative model is inevitable to investigate such stochastic intricacy.
Methods: We proposed a quantitative framework to model MT signalling networks using diverse kinetic parameters linked in its genetic circuits and perturbing them must alter the MT-dynamics. We used a robust computational approach, LogicTRN to decode the systematic controls of the MT-dynamics. It combines multi-layered transcriptome-wide data as input. Computing this returned the regulatory TF-logics in the transcriptional regulatory networks for MT. We developed transcriptional simulations with virtual-knockout mutants and performed genetic network perturbation study.
Results: The results showed the reconstruction of robust quantitative regulatory networks decrypting transcriptional controls for MT-dynamics to estimate the influence of the multiple kinetically distinct inputs affecting those dynamics. This offered competitive advantages in terms of scalability, robustness, and iterations to characterize the effective molecular-targets to modulate the genetic circuit of MT-dynamics effectually.
Conclusion: Quantitative reconstruction and characterization of the regulatory interactome of MT may facilitate us to strategize the adjustments of regulatory controls to effectively modulate MT-dynamics. This foundation may enhance the advancement of circadian and sleep medicine in future.
Support (if any):

016

ASSOCIATIONS BETWEEN CIRCADIAN MELATONIN AND TEMPERATURE AMPLITUDES DURING CONSTANT ROUTINE

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Introduction: Circadian amplitude measures the strength or robustness of a rhythm and changes in amplitude may have implications for health. Large individual differences in melatonin amplitude are recognized. Here we aimed to determine the strength of relationships between melatonin and the core body (CBT) and distal-proximal skin temperature gradient (DPG) amplitudes during a constant routine protocol. Additionally, we determined the best fitting harmonic model for the DPG circadian rhythm.
Methods: 17 young healthy adults [13 males (22.3±3.9yr;mean±SD)] completed a 28-hr constant routine protocol after maintaining 8h habitual sleep schedules for one week at home. Endogenous circadian amplitudes of melatonin and CBT were fit with standard three- and dual-harmonic linear regression models, respectively. The DPG amplitude was analyzed with both dual and three-harmonic regression models to determine which model produced the best fit.
Results: The DPG was best fit by a three-harmonic regression model with significantly lower standard deviation and higher signal-to-noise ratio compared to the 2-harmonic model (both $p<0.05$) as well as by visualization of the fitted curves. Melatonin, CBT and DPG amplitudes were not found to be associated with each other during constant routine (all $r<0.37$; all $p>0.10$).
Conclusion: While it is common for melatonin and body temperature circadian phase estimates to be used interchangeably, non-significant findings for associations between circadian amplitudes of melatonin, CBT and DPG indicate that these markers may not provide similar information about circadian amplitude. Further, research is needed to explore possible associations between individual differences in melatonin, CBT and DPG amplitudes with other physiological and behavioral outcomes to determine which measure(s) of circadian amplitude may be functionally relevant.
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017

THE CIRCADIAN VARIATION OF THE CORTISOL AWAKENING RESPONSE

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Introduction: The Cortisol Awakening Response (CAR) is a rapid increase in cortisol levels at awakening that lasts for about 1 hour. This secretory phenomenon has been proposed to be independent of circadian cortisol regulation. However, the contribution of the circadian system to the CAR remains unclear. The aim of this study is to assess the circadian variation of the CAR.
Methods: A total of eleven healthy participants (1 woman; 22.6 ± 3.4 years old) were enrolled. Following an 8-h baseline sleep period aligned to their habitual sleep times, participants underwent a 72-h ultradian sleep-wake cycle procedure (USW) consisting of 60-min wake periods in dim light (<10 lux) alternating with 60-min nap opportunities in total darkness. Participants remained in a semi-recumbent posture during the procedure. Salivary cortisol samples were collected at 0, 15, 30, and 50 minutes after waking up from each nap. Linear mixed-effects regression analyses were performed on log-transformed cortisol data from wake periods corresponding to the habitual bedtime (biological night) and habitual wake-time (biological morning). These served as proxies of circadian phases characterised by lowest and maximal cortisol secretory activity, respectively. Total cortisol secretion and CAR magnitude during these periods were computed, respectively, as the Area Under the Curve with respect to ground (AUCg) and to increase (AUCi) and compared with paired-samples t-tests.

Results: Significant main effects of wake period (p<.001) and sample time (p=.023) were found, with no interaction (p=.167). Cortisol levels were higher in the biological morning compared to the biological night and increased with elapsed time awake. The total amount of cortisol secreted (AUCg) after waking in the biological morning was significantly greater than during the biological night (p<.001). No significant differences between circadian phases were found in the AUCi (p=.223).
Conclusion: Our study suggests that some features of the CAR may at least partially be under circadian control. These findings are relevant for the understanding of the physiological mechanisms underlying circadian misalignment in shift workers and patients with severe sleep disorders.
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018

THE ROLE OF INFLAMMATORY MARKERS IN SLEEP IN INDIVIDUALS POST-MYOCARDIAL INFARCTION

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Introduction: Despite positive secondary prevention strategies post myocardial infarction (MI), including statin use and lifestyle changes, 32% of the annual MIs are recurrent (MIR). As coronary heart disease is related to atherosclerosis, a chronic inflammatory process, and sleep is associated with cardiovascular disease and innate immunity, understanding the role of sleep and inflammation and MIR is important in developing interventions to improve sleep, reduce inflammation, and delay or prevent MIR. This study aimed to explore the role of sleep quality and inflammatory markers on MIRs.
Methods: We conducted a secondary analysis of cross-sectional data of individuals (N=156) having at least one or more MIs within the last 3 to 7 years. Using the hypothalamus-pituitary-adrenal axis model (Irwin, 2019), we tested sleep quality (Pittsburgh Sleep Quality Index [PSQI]) predicting MIR, using inflammatory markers (hs C-Reactor Protein [CRP], Interleukin-1ß [IL-1ß] and Tumor Necrosis Factor alpha [TNFα]) as the simultaneous indirect paths. Race, sex and body mass index (BMI) were also examined using moderated mediation.
Results: The sample ranged in age from 34 to 92 (M = 65.37, SD = 12.13), BMI averaged 31.11 (SD = 7.34), and was comprised of mostly male (57.1%) and White adults (67.9%). PSQI predicted only IL-1ß (ß= .02; p < .01). IL-1ß predicted MIR (ß = .80, p = .05). The direct effect of PSQI to MIR was not significant (p =.12), the indirect path via IL-1ß was. This relationship was not moderated by race, sex, nor BMI.
Conclusion: IL-1ß is an inflammatory marker elevated after acute MI which does not reflect our selected sample. Inflammation may be an important marker of risk for MIR in those with poor sleep quality. Future studies should examine other markers of inflammation and sleep in those with MIR.
Support (if any):

019

A SIMPLE, OBJECTIVE ESTIMATE OF DIETARY TIMING AS A CIRCADIAN BIOMARKER

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Introduction: The importance of diet for health has been recognized for centuries, yet, the focus has mostly been on what someone eats. Recently, however, focus has expanded to include when someone eats. Experimental studies that manipulated timing of food intake demonstrated effects on metabolic function. Most population-based studies have had to rely on self-reported methods to assess dietary behavior, including food logs or dietary recall, but self-report is subjective, error-prone, and burdensome. The goal of this analysis was to identify an objective estimate of dietary timing in clock time format. Further, we planned to examine whether sleep "chronotype" and this dietary "chronotype" are correlated.
Methods: We used continuous glucose monitoring (CGM), which involves inserting a small sensor into the back of a participant's upper arm. It measures interstitial glucose levels every 5 minutes continuously for up to 2 weeks. We had 13 participants wear a CGM device for 2–10 days. We characterized dietary timing by simply identifying the clock time at which glucose levels were the highest. We identified this time point for each day and then calculated the mean clock time for each participant. Participants also wore wrist actigraphy for approximately one week and we calculated mean sleep start, sleep end, and midpoint times. We calculated intervals between highest glucose and sleep timing measures.
Results: The mean time of highest glucose was 16:57 (SD 3:05) and ranged from 11:16 to 22:27. The mean (SD) intervals were 10.4 (2.9) hours for sleep end to highest glucose, 13.5 (2.8) hours for midpoint to highest glucose, and 5.8 (2.8) hours for highest glucose to sleep start. The correlations between highest glucose and sleep timing were .13 (p=.70) for sleep start, .05 (p=.88) for sleep end, and -.19 (p=.55) for midpoint.
Conclusion: There was a wide range in the timing of highest glucose values in this sample, Further, the timing of highest glucose does not correlate with sleep timing, which indicates that these two timing measures are not redundant with one another. The timing of highest glucose from CGM may provide an objective, simple circadian biomarker of dietary behavior.
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020

SLEEP QUALITY AFFECTS THE PLASMA EXOSOMAL MICRORNA EXPRESSION PROFILE IN MILITARY PERSONNEL WITH TRAUMATIC BRAIN INJURY

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Introduction: Disordered sleep is a critical issue facing the US military due to its negative impact on maintaining force readiness, health, and well-being. Traumatic brain injury (TBI) is highly prevalent among military personnel and commonly co-occurs with disturbed sleep: up to 89% of military service members with TBI report poor sleep quality. Disturbed sleep is a hallmark of post-traumatic stress disorder (PTSD), which often coexists with TBI, with upward of 90% of patients with PTSD reporting some form of sleep disturbance. The pathophysiological mechanisms underlying sleep disturbances in TBI patients remain elusive. Exosomal microRNA (exomiRs), which are implicated in intracellular communication, may provide novel insight into molecular networks related to sleep disturbances in TBI patients.
Methods: ExomiR was extracted from plasma samples of 108 post-9/11 military personnel, and veterans with a history of mild TBI enrolled in a multicenter prospective longitudinal study. ExomiR profiling analysis was conducted using nCounter Human v3 miRNA Expression Panel with 798 microRNA probes. Sleep quality was assessed using

the global score on the Pittsburgh Sleep Quality Index (PSQI), and symptoms of PTSD were measured with the PTSD Checklist for DSM-5 (PCL-5). Generalized linear models and Spearman's correlations were constructed to analyze the relationship between levels of exomiR and global PSQI score.
Results: We found 17 exomiR that were significantly ($P < 0.05$) associated with sleep quality and 11 exomiR significantly associated with PTSD symptoms. Two exomiR, has-miR-1268a and has-miR-139-5p, were significantly associated with both sleep quality and PTSD symptoms. The top three significant exomiR associated with sleep quality were hsa-miR-1250-5p ($r = 0.2295$, $p = 0.0171$), hsa-miR-3615($r = 0.2207$, $p = 0.0229$), and hsa-miR-122-5p($r = 0.2069$, $p = 0.0132$).
Conclusion: Overall, these findings suggest that analysis of exosomal miRNA expression may provide novel insights into the underlying pathobiology of sleep quality in military personnel with mild TBI, independent of PTSD symptoms. Further research is needed to understand the biological underpinnings of poor sleep quality in individuals with TBI and to determine causal links.
Support (if any): Intramural Research Program at the NINR, Department of Defense, Chronic Effects of Neurotrauma Consortium (CENC) Award W81XWH-13-2-0095 and Department of Veterans Affairs CENC Award I01 CX001135.

021

POOR SLEEP QUALITY IN TRAUMATIC BRAIN INJURY PATIENTS IS ASSOCIATED WITH ELEVATED INFLAMMATORY BIOMARKERS

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Introduction: Mild traumatic brain injury (mTBI) and sleep disorders are independently associated with inflammation. Following mTBI, elevated levels of cytokines, such as interleukin-6 (IL-6), 10 (IL-10) and tumor necrosis factor alpha (TNFα), have been observed. These signals are also known to modulate sleep homeostasis. IL-6, IL-10 and TNFα concentrations are typically measured in plasma, but recent work has shown that their measurement in extracellular vesicles (EVs) may hold additional value, as they are shielded from degradation and may be more biologically relevant. We hypothesized that inflammatory biomarkers in chronic mTBI patients would be elevated in poor sleepers.
Methods: In a cross-sectional cohort of warfighters (n=137 mTBI, 44 controls), the Pittsburgh Sleep Quality Index (PSQI) was compared with EV and plasma IL-6, IL-10, TNFα. Protein quantification was performed with Simoa. Two-tailed tests were used with a type I error of $p<0.05$. Linear models controlled for age, sex, and body mass index.
Results: In the mTBI cohort, poor sleepers (PSQI>=10, a published military cutoff) had elevated IL-6 vs. good sleepers (mean [SD] pg/mL, EV: 0.47 [0.63] vs 1.01 [1.54], p=0.04, d=0.44; plasma: 5.00 [13.31] vs 6.88 [13.51], p=0.03, d=0.14). Poor sleepers with mTBI had less EV IL-10 (1.71 [8.18] vs 0.30 [0.54], p=0.017). Comparisons of plasma IL-10 were not significant. No differences in TNFα were observed in mTBI groups. In our model, PSQI was the strongest predictor of EV IL-6 (βstd=0.27, p=0.03) in mTBI patients, whereas only BMI predicted IL-6 in controls. EV IL-6, IL-10, and TNFα correlated with PSQI (R=0.21, p=0.019; R=0.21, p=0.014; R=0.22, p=0.013, respectively), but these relationships were not found with plasma. In controls, no correlations or differences in any biomarker were observed between groups.
Conclusion: Warfighters who report poor sleep had significantly elevated inflammatory biomarkers after chronic mTBI. Cytokine levels in EVs had greater effect sizes between groups compared to plasma levels suggesting EV measurements may have improved signal. Poor sleep and its association with inflammatory cytokines after mTBI may have therapeutic implications.
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022

CYTOKINES AS CORRELATES OF REPORTED SYMPTOMS IN DISORDERS OF HYPERSOMNOLENCE

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Introduction: Cytokines are known for their role in inflammation, and more recently in sleepiness and fatigue. There is a paucity of data regarding cytokines in Idiopathic Hypersomnia (IH) and Narcolepsy Type 2 (NT2) as defined by the International Classifications of Sleep Disorders-Third Edition. Additionally the heterogenous cohort of patients with excessive daytime sleepiness (EDS), but do not meet criteria for a sleep disorder, has not been studied separately from IH patients.
Methods: The study cohort was a convenience sample evaluated at a single tertiary-care sleep center between 2016 and 2019. Diagnoses were IH, NT2, EDS, and controls (based on sleep laboratory testing). The following cytokines were measured using the Mesoscale U-PLEX biomarker assay: G-CSF, IFN-γ, IL-1β, IL-2, IL-4, IL-6, IL-8, IL-10, MCP-1, and TNF-α. Demographic data and survey data pertaining to sleepiness, depression, and sleep inertia were available for all.
Results: The study cohort consisted of 22 controls, 26 patients with EDS, 51 patients with IH, and 12 patients with NT2. There were no significant differences between diagnosis and any cytokine. Pearson correlations showed significant negative correlations between G-CSF concentrations with depression ($p=0.05$) and sleep inertia ($p<0.01$) in patients but not controls. In controls, hours slept per week positively correlated with G-CSF ($p=0.05$), but this was not true in patients with EDS, IH, or NT2. IL-8 level was negatively correlated with reported sleep inertia in sleepy patients ($p=0.05$), but not controls.
Conclusion: Though differences in cytokines levels between diagnostic groups did not reach significance, several cytokines correlated with severity of reported symptoms in disorders of hypersomnolence. G-CSF and IL-8 may serve as a biomarker for symptoms of depression and sleep inertia in sleepiness disorders, and thus could be a targeted for therapies.
Support (if any): Hypersomnia Foundation Grant

023

SLEEP IN A BRAINLESS ANIMAL - THE RELATIONSHIP BETWEEN CENTRALIZATION AND SLEEP IN THE UPSIDE-DOWN JELLYFISH

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Introduction: Though sleep is pervasive in animals, its fundamental roles, and the processes involved in generating the behavior, remain poorly understood. A key outstanding question in sleep regulation is whether sleep is controlled strictly by a top-down mechanism via activity of specific central nervous system (CNS) neurons or is controlled partially by bottom-up signals from neural and non-neural tissue. Recently, we showed that the upside-down jellyfish Cassiopea sleeps, providing an opportunity to study sleep control, regulation, and function in an animal without a CNS.
Methods: Cassiopea have a decentralized nervous system (DNS) of radially spaced interconnected ganglia called rhopalia along their bell margin that control muscle contractions. The signal to contract is sent to muscle fibers local to the initiating ganglion, and the contraction propagates outwards as a point source wave. We have developed computer programs to detect the controlling ganglion, which allows us to non-invasively determine ganglia activity, and to understand how a simple network of ganglia controls behavior. We are also using immunofluorescence, in situ hybridization, qPCR, and RNAseq to characterize the effect of sleep deprivation (SD) on the jellyfish nervous system.
Results: We have discovered a temporally centralized form of behavioral control that changes between day and night, and during SD. A subset of ganglia share behavioral control—while some almost never initiate contractions, others are active both day and night, or are mostly day-active or night-active, and SD drastically changes ganglia usage. Regions that increase activity at night are less active the following day, perhaps evidence of homeostatic regulation. Using RNAseq we found that during SD, one nAChRα subunit increases expression ~3.8-fold and we are studying its role in arousal and sleep.
Conclusion: We are investigating a different kind of nervous system, one that is morphologically decentralized (a network of discrete ganglia), and yet temporally centralized (a subset of ganglia dominate activity control). Wake, sleep, and SD involve different ganglia activity patterns, different levels of centralization, and different gene expression. Thus, temporal centralization could provide a mechanism to explain how local sleep, via a bottom-up mechanism, can result in organismal sleep behavior.
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024

QUIESCENT WAKEFULNESS: CHARACTERISING THE IMPACT OF OXYTOCIN ON SLEEP-WAKE BEHAVIOUR IN MALE AND FEMALE RATS

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Introduction: Oxytocin is a versatile hypothalamic neuropeptide involved in diverse neurobehavioural processes. Since oxytocin can elicit anxiolytic and serenic effects, one could hypothesise that oxytocin should prime the brain for sleep and promote hypnogenesis. However, based on the social salience hypothesis—that oxytocin promotes prosocial behaviour and directs attention toward social stimuli—one could also posit that oxytocin should promote wakefulness. At present, little research has comprehensively characterised the effect of oxytocin on sleep-wake behaviour and no explanation to reconcile these two seemingly competing hypotheses has been proposed.
Methods: This study investigated the effects of oxytocin on sleep-wake outcomes using radiotelemetry-based polysomnography in adult male and female Wistar rats. Oxytocin was administered via the intraperitoneal (IP; 0.1, 0.3 and 1 mg/kg) and intranasal (IN; 0.06, 1, 3 mg/kg) routes. Caffeine (IP and IN; 10 mg/kg) was also administered as a wake-promoting positive control. Additionally, pre-treatment with the oxytocin receptor (OTR) antagonist L-368,899 (IP; 5 mg/kg) and vasopressin 1a receptor (V1aR) antagonist SR49059 (IP; 1 mg/kg) followed by oxytocin (IP; 1 mg/kg) was conducted to determine which receptor(s) mediated sleep-wake effects of oxytocin.
Results: In both male and female rats, IP oxytocin produced dose-dependent effects on sleep-wake behaviour. Specifically, oxytocin initially promoted quiescent wakefulness (a restful but conscious state) at the cost of reducing both active wakefulness and sleep. Throughout the 1.5-hour period post-administration, oxytocin delayed REM sleep onset and reduced the proportion of both NREM and REM sleep. Conversely, IN oxytocin did not significantly alter any sleep-wake parameters at any dose tested. Caffeine demonstrated wake-promoting effects under both the IP and IN routes of administration. The involvement of OTR and V1aR binding in oxytocin-induced effects on sleep-wake outcomes will be discussed.
Conclusion: These findings appear to reconcile the two competing hypotheses: in rats, IP oxytocin appears to promote a state of quiescent wakefulness—one of calm and rest, but also of conscious responsivity to environmental stimuli. IN oxytocin demonstrated little to no effect on sleep-wake behaviour, which is a crucial finding given the escalating use of IN oxytocin as a therapeutic for conditions with comorbid disordered sleep.
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025

SLEEP DISRUPTION ON AN ORBITAL SHAKER ALTERS GLUTAMATE IN PRAIRIE VOLE PREFRONTAL CORTEX

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Introduction: Glutamate concentrations in the cortex fluctuate with the sleep wake cycle in both rodents and humans. Altered glutamatergic signaling, as well as the early life onset of sleep disturbances have been implicated in neurodevelopmental disorders such as autism spectrum disorder. In order to study how sleep modulates glutamate activity in brain regions relevant to social behavior and development, we disrupted sleep in the socially monogamous prairie vole (Microtus ochrogaster) rodent species and quantified markers of glutamate neurotransmission within the prefrontal cortex, an area of the brain responsible for advanced cognition and complex social behaviors.
Methods: Male and female prairie voles were sleep disrupted using an orbital shaker to deliver automated gentle cage agitation at continuous intervals. Sleep was measured using EEG/EMG signals and paired with real time glutamate concentrations in the prefrontal cortex using an amperometric glutamate biosensor. This same method of sleep disruption was applied early in development (postnatal days 14–21) and the long term effects on brain development were quantified by examining glutamatergic synapses in adulthood.

Results: Consistent with previous research in rats, glutamate concentration in the prefrontal cortex increased during periods of wake in the prairie vole. Sleep disruption using the orbital shaker method resulted in brief cortical arousals and reduced time in REM sleep. When applied during development, early life sleep disruption resulted in long-term changes in both pre- and post-synaptic components of glutamatergic synapses in the prairie vole prefrontal cortex including increased density of immature spines.
Conclusion: In the prairie vole rodent model, sleep disruption on an orbital shaker produces a sleep, behavioral, and neurological phenotype that mirrors aspects of autism spectrum disorder including altered features of excitatory neurotransmission within the prefrontal cortex. Studies using this method of sleep disruption combined with real time biosensors for excitatory neurotransmitters will enhance our understanding of modifiable risk factors, such as sleep, that contribute to the altered development of glutamatergic synapses in the brain and their relationship to social behavior.
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026

VASOACTIVE INTESTINAL POLYPEPTIDE DIRECTLY EXCITES NEURONS OF THE SUBPARAVENTRICULAR ZONE

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Introduction: The suprachiasmatic nucleus (SCN) is responsible for generating the circadian rhythmicity in mammals. The ventral region or core of the SCN contains neurons that express the neuropeptide vasoactive intestinal polypeptide (VIP). VIP signaling is central for coherency and synchrony of SCN activity. VIP-expressing neurons in the SCN densely project to the ventral subregions of the subparaventricular zone (vSPZ). We studied the effects of VIP on vSPZ neurons in brain slices of mice with a combined calcium imaging and whole-cell patch-clamp recording techniques. We used calcium imaging to assess the effects of VIP on vSPZ neurons as a population and we acquired patch-clamp recordings to explore the effects of VIP on the electrical properties and the synaptic inputs to vSPZ neurons.
Methods: We expressed GCamp6 in vSPZ neurons by stereotaxically injecting AAV10-DIO-Ef1a-GCamp6 into the vSPZ of vGAT-IRES-Cre mice. Brain slices were prepared two weeks later and images were captured using a standard GFP filter set. We performed whole-cell recordings of the vSPZ neurons of wild-type mice. We assessed the effects of VIP on the membrane potential and the on excitatory synaptic input in vSPZ neurons.
Results: Using GCamp6-based in vitro calcium imaging we found that VIP excites 17% of vSPZ neurons and this effect was maintained in the presence of tetrodotoxin (TTX) and synaptic blockers for AMPA/NMDA and GABAA transmissions suggesting a direct effect of VIP on vSPZ neurons. We confirmed this result with patch-clamp recordings. We found that 29% of vSPZ neurons were excited by VIP. VIP produced a membrane depolarization of vSPZ neurons in the presence of antagonists for AMPA/NMDA and GABAA receptors. In addition, we found that in a small percentage of vSPZ neurons VIP increased the frequency of the glutamatergic excitatory postsynaptic currents, suggesting an additional excitatory mechanism.
Conclusion: Our results demonstrate that exogenous VIP directly excites the vSPZ neurons producing an increase in intracellular calcium and membrane depolarization. In addition, VIP increases glutamatergic afferent inputs to vSPZ neurons indicating an additional synergistic excitation. We conclude that when VIP is released from the SCN VIP fibers it can activate vSPZ neurons.
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027

GABAERGIC NEURONS IN THE DORSAL RAPHE NUCLEUS ARE UNDER THE INFLUENCE OF GABAERGIC INPUTS FROM THE NUCLEUS PONTIS ORALIS

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Introduction: Our previous study has shown that there is a direct connection between GABAergic neurons in the nucleus pontis oralis (NPO) and neurons of the dorsal raphe nucleus (DR), providing a morphological basis for the hypothesis that GABAergic inhibitory processes in NPO play an important role in the generation and maintenance of wakefulness as well as active (REM) sleep through the interaction with neurons in the DR. However, the target of such a GABAergic projection from the NPO within the DR is unknown. In the present study, a double-fluorescent labeling technique was employed to examine the target of GABAergic inputs to the DR.
Methods: Adult cats were deeply anesthetized and perfused transcardially. Subsequently, the brainstem containing the DR was removed, postfixed and cut into 15 µm coronal sections with a Reichert-Jung cryostat. The sections were immunostained with antibodies against GABA-A or GABA-B receptors and GABA following the procedure of double fluorescence immunohistochemistry.
Results: Under fluorescence microscopy, a large number of neurons were labeled with antibodies against either GABA-A receptor or GABA-B receptor. In addition, neurons labeled with antibody against GABA were observed in the DR. With double fluorescence immunohistochemical techniques, some neurons labeled by anti-GABA antibody were also stained with antibodies against GABA-A or GABA-B receptors.
Conclusion: The expression of GABA-A or GABA-B receptors by GABAergic neurons in the DR indicates that GABAergic neurons in the DR receive GABAergic inputs. Our previous study has demonstrated that these GABAergic inputs are from the NPO. These data provide a morphological foundation to support our hypothesis that, during wakefulness, NPO GABAergic "Executive" neurons suppress "Second-Order" GABAergic neurons in the DR, which, in turn, activate (disinhibit) serotonergic wake-on neurons in this nucleus.
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028

SLEEP LOSS DISRUPTS HIPPOCAMPAL MEMORY CONSOLIDATION VIA AN ACETYLCHOLINE- AND SOMATOSTATIN INTERNEURON-MEDIATED INHIBITORY GATE

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Introduction: Sleep loss profoundly disrupts consolidation of hippocampus-dependent memory. To better characterize effects of learning and sleep loss on the hippocampal circuit, we quantified activity-dependent phosphorylation of ribosomal subunit S6 (pS6) across the dorsal hippocampus of mice.
Methods: We first measured pS6 throughout the hippocampus after learning (single trial contextual fear conditioning; CFC), and after

subsequent sleep or sleep deprivation (SD). To characterize cell populations with activity affected by SD, we used translating ribosome affinity purification (TRAP)-seq to identify cell type-specific transcripts on pS6 ribosomes after SD vs. sleep. We next used pharmacogenetics to mimic the effects of SD, selectively activating hippocampal Sst+ interneurons or cholinergic inputs to hippocampus from the medial septum (MS) while mice slept in the hours following CFC. We also inhibited these neuronal populations to assess effects on memory consolidation.

Results: We find that pS6 in enhanced in the dentate gyrus (DG) following single-trial CFC, but is reduced throughout the hippocampus after brief SD – a manipulation which disrupts contextual fear memory (CFM) consolidation. Cell type-specific enrichment analysis (CSEA) of these transcripts revealed that hippocampal somatostatin-expressing (Sst+) interneurons, and cholinergic and orexinergic inputs to hippocampus, are selectively activated after SD. We used TRAP targeted to hippocampal Sst+ interneurons to identify cellular mechanisms mediating SD-driven Sst+ interneuron activation. . We find that activation of Sst+ interneurons is sufficient to disrupt CFM consolidation, by gating activity in surrounding pyramidal neurons, while inhibition of Sst+ interneurons enhances memory consolidation. Similarly, pharmacogenetic activation of cholinergic input to hippocampus from the MS disrupted CFM. Inhibition of MS cholinergic neurons promoted CFM consolidation and disinhibited neurons in the DG, increasing pS6 expression among DG granule cells.

Conclusion: Our data suggest that state-dependent gating of DG activity during SD is mediated by cholinergic input. Together these data provide evidence for an inhibitory gate on hippocampal information processing, which is activated by sleep loss.

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029

MEDIAN PREOPTIC DUAL CONTROL OVER SLEEP REGULATION

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Introduction: Previous studies suggest that the median preoptic nucleus (MnPO) plays an important role in regulating the wake-sleep cycle and in particular homeostatic sleep drive. However, the precise cellular phenotypes, targets and central mechanisms by which the MnPO neurons regulate the wake-sleep cycle remain unknown. Both glutamatergic (Vglut2+) and GABAergic (Vgat+) MnPO neurons innervate brain regions implicated in sleep promotion and maintenance, suggesting that both cell types may participate on sleep control.

Methods: In this study, we used two genetically-targeted approaches associated with electroencephalographic (EEG) and electromyographic (EMG) recordings in Vgat-IRES-cre and Vglut2-IRES-cre mice to investigate the role of the MnPOVgat and MnPOVglut2 neurons in modulating wake-sleep behavior.

Results: First, using a chemogenetic approach, we found that activation of MnPOVgat neurons reduced the latency for the first NREM sleep episode, produced an increase in NREM sleep and reduced wakefulness. Then, to test the role of MnPOVgat and MnPOVglut2 neurons in regulating sleep homeostasis, we recorded EEG and EMG responses in mice that had the Vgat+ or Vglut2+ neurons deleted from the MnPO. After deletion of MnPOVgat neurons, mice showed a reduction of NREM sleep and an increase in wakefulness during the light phase. Deletion of MnPOVgat neurons also reduced sleep recovery after 4 hours of sleep deprivation (SD). On the other hand, deletion of the MnPOVglut2 neurons did not change the wake-sleep cycle during the 24h baseline condition, but prevented the sleep recovery immediately after SD. To understand the underlying mechanism in preventing sleep recovery in both MnPOVglut2- and MnPOVgat-deleted mice groups, we exposed these animals to a psychological stress protocol. In response to a psychological stressor, mice with deletion of glutamatergic, but not GABAergic MnPO neurons, had an exacerbation of the stress-induced insomnia.

Conclusion: Our results suggest that both neuron populations differentially participate in wake-sleep control, with MnPOVgat neurons being critically involved in sleep homeostasis, and MnPOVglut2 neurons promoting sleep during allostatic (stressful) challenges.

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030

THE SLEEPING BRAIN SWITCHES FROM FRONTAL-SUBCORTICAL WORKING MEMORY TO HIPPOCAMPAL EPISODIC MEMORY PROCESSING DURING NREM SLEEP.

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Introduction: Working memory (WM) and long-term memory (LTM) serve separate functions. The former is a control process for planning and carrying out behavior that is information-independent, whereas the latter is an information-dependent vast store of knowledge and record of prior events. Both domains benefit from sleep. The overall picture emerging is that NREM sleep supports improvement in WM via strengthening of prefrontal-subcortical control networks, as well as the formation of LTM via thalamocortical sigma activity. Prior research suggests a potential antagonistic relation between the two neural processes during NREM sleep. Yet, how the sleeping brain performs both of these feats remain unknown.
Methods: Thirty-eight adults (age = 20.85 ± 2.97 years, 19 Females) were enrolled. We used a double-blind, placebo-controlled, within-subject design to investigate the role of autonomic and central activity on sleep-dependent LTM and WM improvement. We administered zolpidem, a GABA-A agonist, during PSG-recorded night and tested overnight LTM (word-paired-associates) and WM memory (operation-span) changes. We used effective connectivity to explore the causal information flow between central and autonomic sleep features and tested if the magnitude of this influence predicts the trade-off between overnight LTM and WM improvement.
Results: The intervention selectively suppressed vagal cardiac autonomic activity and increased sleep spindle sigma activity (12-15Hz) during non-rapid eye movement sleep (NREM). Behaviorally, the changes in sigma were associated with increased LTM and decreased WM improvement. Effective connectivity demonstrated a significantly decreased communication from autonomic to central regions with zolpidem compared with placebo, and this decrease in causal influence predicted the behavioral trade-off between LTM and WM.
Conclusion: Our results suggest evidence for a sleep switch that toggles between spindle-dependent and vagal-dependent processes during NREM. This switch supports enhancement of both LTM and WM during sleep via separate mechanisms. These results are consistent with prior studies reporting an antagonistic relation between neuromodulators governing the two systems, thalamocortical GABA and noradrenergic (NE) activity, respectively.
Support (if any):

031

THE REDUCED BENEFIT OF SLEEP FOR MEMORY TRACE CONSOLIDATION WITH AGE

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Introduction: Sleep is known to enhance the realization of novel solutions to problems. As we age, both the quantity and quality of sleep are reduced. Age-related deficits in sleep-dependent memory consolidation have been recently identified, however, the scope of these deficits is not. Here, we sought to investigate the behavioural and neuronal functional consequences of age-related changes in sleep for gaining insight into novel cognitive strategies (e.g., on the Tower of Hanoi; ToH).
Methods: 40 healthy young adults (20–25 years), and 30 healthy older adults (60–85 years) participated, and were assigned to either the nap [young-nap (YN), older-nap (ON)] or wake [young-no-nap (YNN), older-no-nap (ONN)] conditions. Participants were trained on the ToH in the AM, followed by either a 90 minute nap opportunity or a period of wake, and were retested afterward. The ToH is a procedural task that requires the acquisition of a novel cognitive strategy (i.e., recursive logic). Alternating blocks of ToH practice and rest were performed while functional MRI scans were obtained at 3T to examine differences (pFDR<0.05) in brain activation from training to retest in young vs. older groups as a function of sleep [(YN-YNN)-(ON-ONN)].
Results: Sleep significantly benefitted the young but not the older participants (speed and accuracy) on the ToH. A bilateral difference in activation of the hippocampus was observed from training to retest between young and older subjects. Specifically, YN displayed decreased activation, whereas YNN showed increased activation. The older groups showed the opposite pattern whereby ON displayed increased activation whereas ONN showed decreased activation. The same pattern was observed for the middle temporal gyrus and medial prefrontal cortex. By contrast, the opposite pattern was observed in the premotor area, inferior and superior parietal cortex.
Conclusion: These results suggest that sleep differentially contributes to the realization of a novel cognitive strategy in young vs. older individuals, consistent with the notion that as the consolidation of a newly formed memory trace progresses, the hippocampus becomes less involved over time; especially so when sleep occurs during that time. Our results suggest that sleep preferentially contributes to this process in the young, but not in older individuals.
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032

SLEEP CONSOLIDATES MEMORY FOR STRONG BUT NOT WEAK INFORMATION AFTER INCIDENTAL ENCODING

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Introduction: Slow wave sleep (SWS) strengthens memory for studied information, but research on the effect of sleep on information that is not intentionally remembered is scarce. Previous research from our lab suggests sleep consolidates some information that has been encoded incidentally, meaning that it has been acted on but not intentionally remembered. It remains unclear what determines which information is consolidated during sleep after incidental encoding and what aspects of sleep are related to this mnemonic benefit. In two experiments, we test the hypothesis that sleep consolidates strong but not weak memory traces following incidental encoding and assess the relationship between memory performance and sleep attributes.
Methods: In Experiment 1, we manipulated memory strength within- and between-subjects. Participants rated words one or three times (within) in a shallow or deep incidental encoding task (between). In the shallow task, participants counted vowels in each word; in the deep task, participants rated each word on a scale from 'concrete' to 'abstract'. Following a 12-hour period containing sleep or wakefulness, participants took a surprise memory test. In Experiment 2, participants rated words one or three times in the deep encoding task, received an 8-hour sleep opportunity with partial PSG, and took the surprise memory test.
Results: In Experiment 1, participants remembered words better after sleep than wake regardless of number of encoding trials, but only after deep encoding. There was not an effect of sleep following shallow encoding. In Experiment 2, SWS correlated negatively with response latency for correctly recognized words encoded once, but not those encoded three times. That is, participants who received more SWS showed faster performance.

Conclusion: Results suggest sleep consolidated information based on the depth of encoding, and this benefit was related to SWS. This work is broadly consistent with theories of memory consolidation that predict sleep is more beneficial for strong than weak memory traces, such as the synaptic downscaling hypothesis.
Support (if any):

033

THE EFFECT OF SLEEP DISTURBANCE ON COGNITION IN LATE-LIFE DEPRESSION

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Introduction:: Late-life depression is the most common psychiatric disorder in older adults and is associated with cognitive deficits, however, the role of sleep disturbance in cognitive deficits is poorly defined. In the current study we aimed to examine sleep macro and micro-architecture differences between those with late-life depression and controls. Secondly, we sought to determine how sleep changes relate to clinical memory and executive function measures in those with late-life depression and controls.
Methods: Using prior clinical data, this retrospective study assessed adults >50 years who had completed an overnight PSG study and comprehensive psychiatric, neuropsychological, and medical assessment. Memory performance was measured using the Weschler Memory Scale logical Memory 1 and 2 components, Rey Auditory Verbal Learning Test (Senior) 30-minute recall and Rey Complex Figure 3-minute recall. Executive function was defined by z scores from Trail Making Test, D-KEFS Stroop Test and Controlled Oral Word Association Test. The sample comprised of 71 depressed participants, defined by a Geriatric Depression Scale score ≥6, and 101 non-depressed participants (GDS <6 and no lifetime history of depression using DSM-IV criteria).
Results: Contrary to our hypothesis no significant macroarchitectural differences were observed between the groups. Less time spent in slow-wave sleep (SWS) was associated with worse delayed memory recall scores in the depression group (z=.342, p=0.008) although this was not seen in the control group. SWS and slow wave activity (SWA) were not related to measures of executive function performance. Depressed participants demonstrated a reduced level of sleep spindles (Dep= 159 ±142.8, con= 213±163, p=.03) although there were no associations with memory outcomes.
Conclusion: Compared to younger adults with depression, macroarchitectural differences in those with late-life depression are not as pronounced, due to a reduction of SWS and SWA power as a function of ageing. The efficiency of SWS hippocampal dependent memory processes in depression may be reduced, therefore, more time spent in SWS is related to better memory performance. This study assessed the density of sleep spindles but not spindle and slow wave oscillation coupling which may be more important for hippocampal dependent memory.
Support (if any):

034

DREAMING AS CONSTRUCTIVE EPISODIC FUTURE SIMULATION

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Introduction: Memories of the past help us respond to similar situations in the future. The "episodic future simulation" hypothesis proposes that waking thought combines fragments of various past episodes into imagined simulations of events that may occur in the future. We asked whether this framework from waking cognitive neuroscience may be useful for understanding the function of sleep and dreaming. We hypothesized that participants would commonly identify future events as the source of a dream. Further, we expected future-oriented dreams to draw on multiple different waking memories, with fragments of past experience combined into novel scenarios relevant to anticipated events in participants' personal futures.
Methods: N=48 students spent the night in the laboratory with polysomnographic recording. During the night, participants were awakened up to 13 times to report on their experiences during sleep onset, REM and NREM sleep. The following morning, participants identified and described waking life sources for each dream reported the previous evening. A total of N=481 reports were analyzed.
Results: While dreams were most commonly traced to past memory (53.5% of reports), more than a quarter (25.7%) were related to specific impending future events. Nearly half of reports with a waking source were traced to multiple different sources (49.7%). Over a third of dreams with a future event source were additionally related to one or more specific past episodic memories (37.4% of all reports with a future episodic source). Future-oriented dreams became proportionally more common later in the night.
Conclusion: First, we confirm prior reports that dreams not only reflect past memory, but also anticipate probable future events. Furthermore, these data provide a novel description of how future-oriented dreams draw simultaneously from multiple waking-life sources, utilizing fragments of past experience to construct novel scenarios anticipating future events. The proportional increase of future-oriented dreams later in the night may be driven by temporal proximity to the events of the following day. While these dreams rarely depict future events realistically, the activation and recombination of future-relevant memory fragments may nonetheless serve an adaptive function.
Support (if any): This work was supported by Bursaries award 83/12 from the BIAL Foundation.

035

ACTIVATING THE CONCEPT OF "RELAXATION" DURING SLEEP USING RELAXATION-RELATED WORDS

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Introduction: Cognitive processes (e.g., rumination, perception of an unfamiliar sleeping environment, relaxation techniques) alter our sleep, but the underlying mechanisms are still unknown. Theories of embodied or grounded cognition assume that semantic meaning is stored in multimodal neuronal networks. We therefore assume that cognitive concepts are closely linked to related bodily functions. We propose that mental processes are active to a greater or lesser extent during sleep and that this degree of activation affects our sleep depth.
Methods: We examined this notion by activating the concept of "relaxation" during sleep using relaxation-related words in 50 healthy participants. After an adaption night, subjects slept in the sleep laboratory for two experimental nights according to a within-subject cross-over design. During one experimental night, relaxing words (e.g., "sea", "relax") were presented to promote sleep depth. During the other experimental night, control words were presented (e.g., "produce", "materials"). As the amount of SWS peaks within the first sleep cycle, words were presented during NREM sleep starting with the second sleep cycle (at the latest 120 min after sleep onset). In addition, a mood and a subjective sleep quality questionnaire was conducted.

Results: In support of our hypothesis, playing relaxing words during non-rapid eye movement sleep extended the time spent in slow-wave sleep during the period, when words were presented. Furthermore, power in the slow-wave activity band was increased several seconds after the cue for relaxing compared with control words. The increased sleep depth by means of relaxing words was accompanied by a reduced interhemispheric asymmetry of SWA and slow-wave density in the during-cueing period. The changes observed in objective sleep translated to the subjective level with an increase in subjective sleep quality and alertness ratings.
Conclusion: The present study showed that the semantic meaning of words presented during NREM sleep is capable of affecting sleep physiology, SWS maintenance and the subjective evaluation of sleep quality. Our results support the notion that the activation of mental concepts during sleep can influence sleep depth and provide a basis for interventions using targeted activations to promote sleep depth and sleep quality to foster well-being and health.
Support (if any):

036

THE EFFECT OF EXERCISE ON SLEEP ARCHITECTURE AND MEMORY CONSOLIDATION DURING A DAYTIME NAP

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Introduction: Slow wave sleep (SWS) is thought to especially benefit declarative memory (i.e., memory for facts and events). As such, recent studies have used various methods to experimentally increase the amount of slow wave sleep that participants obtain, with the goal of assessing how SWS affects declarative memory consolidation. Studies dating back decades have reported that exercising before sleep may increase time spent in SWS. Thus, the aim of the current project was to determine whether exercising after learning verbal information enhances slow wave sleep during a subsequent nap and/or enhances memory for verbal information.
Methods: Participants who exercised regularly were recruited to attend two 2.5hr laboratory sessions. During each session, they trained on a paired associates learning task and then completed either a 20min cardiovascular exercise routine or a 20min stretching routine. Following a 1hr nap opportunity, participants were tested on their memory. PSG was recorded during the nap, and scored following AASM criteria. Participants were excluded from analysis if they failed to sleep for at least 10 min. Following exclusions, n=30 participants were included in analysis.
Results: Contrary to our hypotheses, there was no significant difference between the exercise and stretching conditions for minutes spent in slow wave sleep (p=.16), % time spent in slow wave sleep (p=.22), or raw improvement in paired associated performance (p=.23). The amount of SWS obtained during the nap did not correlate with performance in either condition (SWS min vs. memory in exercise condition: r28=.10, p=.60; sleep condition: r28=-.06, p=.74). Exercise did not affect time spent in any other sleep stage, nor did it affect total sleep time.
Conclusion: Contrary to our hypotheses and the results of prior research, we were unable to detect a significant effect of exercise on slow wave sleep. Also contrary to our hypotheses, exercise did not affect memory retention across the nap interval. These null results could indicate that there is no effect of exercise on nap sleep and/or associated memory retention. However, it could also be that we lacked sufficient power to detect effects that were smaller than expected.
Support (if any):

037

SUBJECTIVE SLEEP AND OBJECTIVE COGNITION IN MIDDLE-AGED AND OLDER ADULTS: DOES SEX MATTER?

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Introduction: Worse sleep has been linked to cognitive dysfunction in aging populations. There are known sex differences in the prevalence and presentation of both sleep disturbance and cognitive impairment, but research investigating sex differences in the associations between sleep and objective cognition is limited and inconclusive. We examined sex as a moderator of associations between self-reported sleep and objective cognitive performance in middle-aged/older adults.
Methods: Sixty-four adults aged 50+ (Mage= 63.8, SD=7.7; 33 men/31 women) who were cognitively healthy (no mild cognitive impairment, dementia or neurological disorders) completed an online survey (via Qualtrics) measuring self-reported sleep (Pittsburgh Sleep Quality Index; PSQI). Participants completed online cognitive tasks (via Inquisit) measuring inhibition (Stroop task; interference reaction time scores), attentional orienting (Posner Endogenous Cueing Task; reaction time difference between invalidly cued and validly cued trials), and working memory (Sternberg task; proportion correct). Multiple regressions examined whether PSQI subscores (sleep quality, sleep duration, sleep efficiency) were independently associated with or interacted with sex in their associations with cognition, controlling for age and education.
Results: Sex interacted with sleep quality in the association with endogenous attentional orienting (p=.01, R-squared=.10). Specifically, worse sleep quality was associated with worse attentional orienting in women (B=22.73, SE=9.53, p=.02) but not men (p=.24). Sex interacted with PSQI-sleep duration (p=.03, R-squared=.08) and PSQI-sleep efficiency (p=.03, R-squared=.08) in the association with inhibition performance. Specifically, worse sleep duration (B=235.28, SE=77.51, p=.004) and sleep efficiency (B=211.73, SE=68.70, p=.003) were associated with worse interference scores in men but not women (ps>.05). No variables were associated with working memory.
Conclusion: In middle-aged and older adults, sex moderates associations between self-reported sleep and objective cognition, depending on the sleep parameter and cognitive ability assessed. Findings suggest that women are more vulnerable to the effects of poor sleep quality on spatial attention, whereas men are more vulnerable to the effects of shorter sleep duration and worse overall sleep fragmentation on ability to inhibit task-irrelevant stimuli. Future studies should investigate sex-specific associations between sleep and cognition over time in order to better understand the prospective trajectories of these processes during aging.
Support (if any):

038

SLEEP AND HIPPOCAMPAL FUNCTION DURING AN ASSOCIATIVE MEMORY TASK ARE INFLUENCED BY SURGICAL MENOPAUSE AT MIDLIFE

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Introduction: 17β-estradiol loss is related to Alzheimer's disease (AD) risk factors, including disordered sleep and associative memory decrements. Women have higher risk for AD than men, and those with midlife 17β-estradiol loss due to surgical menopause, including bilateral salpingo-oophorectomy (BSO) before age 48, have even higher risk. We wondered whether sleep and associative memory in women with BSO (mean age 44–46) would be comparable to those with spontaneous/natural menopause (SM; mean age 57), and whether 17β-estradiol-based hormone therapy (ET) might mitigate these effects.
Methods: We assessed sleep using the average of three nights of portable polysomnography (Temec) in women with BSO either taking ET (BSO+ET; n=16), or not (BSO; n=18), and in older spontaneously menopausal women (SM; n=14). Using EEG (Fp1-Fp2), we obtained sleep staging automatically (Neurobit Technologies). Participants also completed a face-name associative memory task during functional magnetic resonance imaging. Recognition accuracy and brain activation during encoding were measured.
Results: BSO exhibited reduced sleep efficiency compared to BSO+ET. For BSO, there was no relationship between percent of total sleep time in N3 and hippocampal activation during associative encoding, even though percent of total sleep time in N3 was negatively associated with hippocampal activation during associative encoding in BSO+ET. For all groups, including BSO, lower latency to consolidated N3 correlated with better associative memory accuracy. There were no group differences in associative memory accuracy. In contrast to BSO, SM showed significantly longer latency to consolidated N3 than BSO+ET.
Conclusion: Younger women with BSO have comparable sleep to older women in SM. In younger women with BSO, ET improves sleep efficiency. Further, while associative memory may be disrupted by increased latency to consolidated N3 in all women, BSO and BSO+ET showed similar associative memory accuracy and latency to consolidated N3. Only BSO+ET exhibited a significant correlation between hippocampal activity during associative encoding and time spent in N3, indicating that ET may support the negative relationship between N3 and hippocampal function. Overall, ET in younger women with BSO potentially ameliorates poor sleep and associative memory decrements.
Support (if any): Alzheimer's Association/Brain Canada Foundation: AARF-17-504715; Wilfred and Joyce Posluns Chair in Women's Brain Health and Aging

039

SLEEP PREFERENTIALLY SUPPORTS PROBLEM-SOLVING SKILLS VIA GREATER FUNCTIONAL CONNECTIVITY BETWEEN THE CAUDATE AND CEREBRAL CORTEX

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Introduction: Sleep consolidates memory, including newly acquired procedural skills. One putative systems-level mechanism for this function of sleep is via sleep-dependent strengthening of functional connectivity between the putamen and the cortico-hippocampal-striatal-cerebellar network, which supports procedural motor skills. For procedural motor skills that also require problem solving and rule-learning, sleep preferentially benefits the cognitively complex aspects over the motor skills required to execute the solution itself. The caudate is implicated in higher-order cognitive components of skill learning, which include error monitoring and automizing new information. In the current study, we investigated how sleep alters functional connectivity in higher-order learning networks that support problem solving and rule learning-related procedural skills.
Methods: Participants (n = 38) were trained on a procedural skills task; the Tower of Hanoi (ToH), that requires the acquisition of a novel cognitive strategy (e.g., recursive logic), while undergoing functional magnetic resonance imaging (fMRI). After either a full night of sleep (n=19) or a full day of wakefulness (n=19), participants were retested on the same task in the fMRI. Resting state activity was acquired before (R1) and after the training session (R2), and before the retest session (R3).
Results: Behavioral performance on the ToH improved following sleep compared to wake (reduced number of errors: $t(38)=2.92$, $p=0.006$, $d=1.24$). Regions associated with higher-order learning and cognitive complexity (i.e., the caudate) and regions typically implicated in sequence learning (i.e., the putamen, hippocampus, cerebellum) were selected as regions of interest (ROI). Increased functional connectivity across the retention interval (R3-R2) was observed in the sleep vs. wake condition between the caudate and the motor cortex ($t(36)=3.32$, $p=0.042$, FWE). By contrast, changes in functional connectivity were not observed between the putamen and other ROIs.
Conclusion: These results suggest that sleep supports improved consolidation of motor skills that involve the acquisition of a novel cognitive strategy. Sleep enhanced functional connectivity in brain areas associated with higher-order cognitive skills (i.e., the caudate), but not regions typically associated with motor skills (i.e., the putamen) that are required to execute the solution to the cognitive procedural skill.
Support (if any): Natural Science and Engineering Research Council of Canada

040

SLEEP DEPRIVATION DISRUPTS BINDING OF INFORMATION WITH ITS CONTEXT

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Introduction: Effective memory often requires recall of both specific information and the context in which the information was encountered. Total sleep deprivation (TSD) is known to impair memory for information items (e.g., words on a studied list), but the impact of TSD on binding, or associative linking, between items and context is not clear.
Methods: N=68 healthy adults (ages 22–40; 35 females) completed a 4-day (3-night) in-laboratory study. After a baseline night with 10h nighttime sleep opportunity, participants were randomly assigned to either 38h TSD (n=38) or a well-rested control (WRC) condition with 10h nighttime sleep opportunity (n=30). Both study arms concluded with a 10h nighttime recovery sleep opportunity. Participants completed a standardized recognition memory task at 14:50 on day 2 (baseline, session 1) and again 24h later (session 2). The memory task consisted of a study phase in which words with negative, positive, and neutral affective valence were spoken by a female or male speaker (50% each); followed immediately by a test phase, in which subjects made recognition judgments for the items (words) and their source (speaker).
Results: Mixed-effects ANOVA revealed significant interactions of session by condition for both word and speaker recognition ($p<0.001$). When sleep-deprived, TSD participants recognized fewer words and, for words that were correctly recognized, they were worse at recognizing the speaker, compared to baseline and to the WRC group. Negatively valenced words were associated with poorer word recognition ($p<0.001$), and in session 1 poorer source recognition ($p = 0.032$), but these valence effects did not interact with sleep deprivation.
Conclusion: TSD impaired memory for items, but more importantly, also impaired memory for the context in which items were presented,

even if the items were themselves correctly recognized, and regardless of their affective valence. These results indicate that TSD may disrupt binding of information to its context, which could explain TSD deficits in decision-making tasks that require novel associative linking. Furthermore, our findings are important in real-world situations such as eyewitness accounts and perseveration of the influence of misinformation.
Support (if any): NIH grant R21 CA167691 and CDMRP award W81XWH-20-1-0442

041

ALTERATION OF THREAT-RELATED INFORMATION PROCESSING DURING EXTENDED SLEEP DEPRIVATION

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Introduction: Threat-related information is preferentially processed, facilitating quick and efficient responses. However, the impact of extended sleep deprivation on perception of and response to threatening information is not well known. Sleep loss may increase amygdalar activity and negative mood, potentially facilitating threat processing. However, it also reduces cognitive function, possibly impairing ability to respond. The present study assessed the extent to which extended sleep deprivation modulates threat processing using a threat expectation paradigm.
Methods: Twenty-one participants underwent one baseline night of sleep followed by 62hrs total sleep deprivation (TSD) and one recovery night of sleep (12hrs). Threat expectation task performance was assessed at baseline, at multiple time points during TSD, and following recovery sleep. To control for circadian influence, performance at three 1100 sessions (baseline, 52hrs into TSD, and recovery) were compared. The threat expectation task involved determining whether a presented face was fearful (i.e., signaled threat) or neutral. Faces were presented at three expectation levels: 80%, 50%, and 20% chance of viewing a fearful face.
Results: Overall, responses were faster ($F=9.77$, $p=0.001$) and more accurate ($F=11.48$, $p=0.001$) when the type of face (fearful or neutral) was expected. Accuracy significantly decreased over TSD ($t=7.71$, $p<0.001$) and recovered following subsequent sleep. Fear bias was calculated for accuracy (accuracy for fearful face minus neutral face). Under conditions of high expectation (80%) of viewing a fearful face, fear bias increased across TSD ($t=-1.95$, $p=0.07$). Although accuracy to both fearful and neutral faces significantly declined across TSD (both $p<0.001$), decline for neutral faces was greater, thus increasing fear bias. Importantly, the increased bias toward fear was still evident compared to baseline following a 12-hour recovery sleep opportunity, ($t=-1.93$, $p=0.07$).
Conclusion: Extended sleep deprivation, common in operational environments where there is also high expectation of encountering threat, impairs cognitive control and is thought to enhance amygdala activity. These data show that, consequently, cognitive resources become biased toward biologically adaptive behaviors (i.e., threat processing) at the expense of attending and responding more broadly to all stimuli. This behavior is not reversed with a single extended sleep opportunity.
Support (if any): Department of Defense Military Operational Medicine Research Program (MOMRP)

042

A LOOK AT SEX DIFFERENCES ON SLEEP'S IMPACT ON WORKING MEMORY IMPROVEMENT

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Introduction: Studies have shown that sleep affects working memory (WM) improvement, but specific electrophysiological features are unclear (Sattari et al., 2019; MacDonald et al., 2018). In addition, sex differences have been found in both sleep and working memory (Mong, 2016; Harness, 2008). The goal of this study is to identify sex differences in EEG correlates of working memory over a night of sleep.
Methods: Sixty-three healthy (33 females), college-aged adults without sleep disorder were enrolled. A 32-channel electroencephalogram (EEG) cap was used to record brain activity during sleep. Operation span (OS) task was used to evaluate WM performance. Participants reported to the laboratory in the evening, performed OS before sleep (test1) and after sleep (test2). Trials were divided into easy and hard trials based on the number of letters subjects had to recall. A repeated-measure analysis of variance was conducted to examine the effects of time and trial difficulty. Paired-sample t-tests between test 1 and test 2 were conducted for males and females. Pearson's correlations were examined between WM performance at test 1 and the difference score between test 1 and test 2 and EEG frequency bands. The Benjamini–Hochberg method was used to control for multiple comparisons.
Results: There was an increase in performance across the night in WM hard trials across all subjects ($F(1,62)=4.86$, $p=0.03$), no effect for easy trials ($p>0.05$). Females, but not males, showed a significant decrease in easy trials ($t62= 2.40$, $p=0.02$), while both males and females showed improvement in hard trials across the night. Females showed a positive correlation between test 1 hard trials and slow sigma, delta, slow oscillation in stage 3, this correlation is not seen in males. No correlations between overnight improvement and EEG bands were found.
Conclusion: Consistent with previous studies, participants showed better memory performance over a night of sleep, and the WM performance was associated with slow wave activity in females. Slow sigma also plays a role in the WM performance for females, indicating a possible role of sleep spindles. These associations were not shown in males, suggesting sex hormones mediate sleep's impact on WM performance.
Support (if any):

043

SLEEP RESTRICTION AFFECTS MEMORY IN HEALTHY ADULTS: PRELIMINARY FINDINGS

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Introduction: Sleep loss has a range of detrimental effects on cognitive ability. However, few studies have examined the impact of sleep restriction on neuropsychological function using an experimental design. The goal of this study was to examine the extent to which maintained insufficient sleep affects cognition in healthy adults compared to habitual adequate sleep.
Methods: This study used a randomized, crossover, outpatient sleep restriction design. Adults who regularly slept at least 7 h/night, verified by 2 weeks of screening with actigraphy, completed 2 phases of 6 weeks each: habitual sleep (>7 h of sleep/night) or sleep restriction (habitual sleep minus 1.5 h) separated by a 6-week washout period. During the sleep restriction phase, participants were asked to delay their bedtime by 1.5 hours/night while maintaining their habitual wake time. Neuropsychological function was evaluated with the NIH Toolbox Cognition Battery at baseline (week 0) and endpoint (week 6) of each intervention phase. The NIH Toolbox evaluates a range

of cognitive abilities, including attention, executive functioning, and working memory. General linear models with post hoc paired t-tests were used to assess demographically-adjusted test scores prior to and following each sleep condition.

Results: At the time of analyses, 16 participants were enrolled (age 34.5□14.5 years, 9 women), 10 of whom had completed study procedures. An interaction between sleep condition and testing session revealed that individuals performed worse on List Sorting, a working memory test, after sleep restriction but improved slightly after habitual sleep ($p<0.001$). While not statistically reliable, the pattern of test results was similar on the other tests of processing speed, executive function, and attention.

Conclusion: In these preliminary results from this randomized experimental study, we demonstrated that sleep restriction has a negative impact while stable habitual adequate sleep has a positive impact on working memory, or the ability to temporarily hold information in mind while executing task demands. This finding contributes to our understanding of the complex interplay between different aspects of sleep quality (i.e., both sleep restriction as well as the maintenance of stable sleep patterns) on cognition and underscores the importance of routine sleep screening as part of medical evaluations.

Support (if any):

044

SLOW OSCILLATORY TRANSCRANIAL DIRECT CURRENT STIMULATION ENHANCES COGNITIVE PERFORMANCE DURING SUBSEQUENT SLEEP DEPRIVATION

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Introduction: The EEG slow oscillation of < 1 Hertz frequency has been implicated in various sleep functions, sparking a recent interest in slow oscillation enhancement strategies. In a seminal study, Marshall et al. (2006) demonstrated that 25 minutes of a slow oscillatory form of transcranial direct current stimulation (SO-tDCS) during early nocturnal sleep improved subsequent retention of word pairs learned prior to sleep, consistent with a proposed role for the slow oscillation in sleep-related memory consolidation. Another proposed function of the slow oscillation is synaptic downscaling, hypothesized to constitute the physiological basis for satisfying the homeostatic drive for sleep, per the synaptic homeostasis hypothesis of Tononi and Cirelli. We sought to determine if SO-tDCS could enhance the restorative properties of sleep, by enhancing slow oscillation activity, during a restricted sleep opportunity by assessing performance during a subsequent period of sleep deprivation (SD).

Methods: Twenty-six healthy volunteers were randomized into two groups. Participants either received electrical stimulation with 50 minutes of SO-tDCS at 0.75Hz, or sham stimulation, during the second hour of a restricted two hour sleep opportunity (11:00PM TO 1:00AM), followed by a 46 hour period of SD and then two recovery nights of sleep. Vigilance was assessed periodically with the Psychomotor Vigilance Test (PVT) during a baseline day, SD, and during the two days following recovery sleep nights.

Results: A mixed linear regression revealed significant main effects of day, group, and the interaction between group and day on mean reaction time (RT). Posthoc analysis revealed faster RTs following stimulation on day 2 of SD. It was also found that participants in the stimulation group had fewer major lapses (RTs > 500 ms) than those in the sham group over the first three days following stimulation.

Conclusion: Slow oscillatory transcranial direct current stimulation during a portion of a restricted period of sleep appears to enhance sleep's restorative properties and improves cognitive performance during subsequent sustained wakefulness. The mechanistic basis for this phenomenon may be increased slow oscillation induced synaptic renormalization.

Support (if any): Department of Defense Military Operational Medicine Research Program (MOMRP)

045

ASSOCIATIONS OF ACTIGRAPHIC SLEEP AND CIRCADIAN REST/ACTIVITY RHYTHMS WITH COGNITION IN THE EARLY PHASE OF ALZHEIMER'S DISEASE

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Introduction: Alterations in sleep and circadian rhythms are common in persons with Alzheimer's disease (AD) dementia, but the nature of such changes in the early phases of AD remains unclear. This study compared sleep and circadian rest/activity rhythms (RARs), measured by standard and novel actigraphic indices, between participants with normal cognition or mild cognitive impairment (MCI), and examined cross-sectional associations between these measures and cognition.

Methods: Actigraphy data were collected in 179 individuals (mean age=72.6 years, gender=64.8% female) with normal cognition (n=153) or MCI (n=26) from the Biomarkers for Older Controls at Risk of Dementia (BIOCARD) study. Standard sleep parameters (i.e., total sleep time [TST], sleep efficiency [SE], wake after sleep onset [WASO], average wake bout length [WBL]), and standard non-parametric RAR metrics (i.e., relative amplitude [RA], intradaily variability [IV], interdaily stability [IS]) were generated. Functional principal component (fPC) methods were used to generate three novel RAR indices (fPC1, fPC2, fPC3) representing 69% of the total variance. Cognitive test scores were used to generate composite measures reflecting the domains of episodic memory and executive function using factor analysis. Regression models were used to compare sleep and circadian RAR parameters between the diagnostic groups and to evaluate their associations with cognitive performance.

Results: After adjustment for age, sex, education, and APOE-4 genotype, compared to normal controls, MCI subjects had significantly lower SE, lower RA, and lower scores on the novel RAR measure fPC3, which reflects a later rhythm phase, lower amplitude, and lower activity both at night and early in the day. In analyses combining data from participants with MCI and controls, several standard RAR parameters (e.g., higher RA and IS) and higher fPC3 scores were associated with both better episodic memory and executive function. Additionally, several standard measures (e.g., lower WASO and IV) and lower fPC1 scores (reflecting higher rhythm amplitude and greater activity throughout daytime hours) were linked with better executive function.

Conclusion: MCI participants have sleep and circadian alterations, which are significantly associated with cognitive performance. A novel RAR measure, fPC3, showed differences in rhythm patterns that extended from the night into the daytime.

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046

SLEEP-DEPENDENT PROSPECTIVE MEMORY CONSOLIDATION IS IMPAIRED WITH AGING

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Introduction: Existing literature suggests that sleep-dependent memory consolidation is impaired in older adults but may be preserved for personally relevant information. Prospective memory (PM) involves remembering to execute future intentions in a timely manner and has behavioural importance. As previous work suggests that N3 sleep is important for PM in young adults, we investigated if the role of N3 sleep in PM consolidation would be maintained in older adults.
Methods: 49 young adults (mean age±SD: 21.8±1.61 years) and 49 healthy older adults (mean age±SD: 65.7±6.30 years) were randomized into sleep and wake groups. After a semantic categorization task, participants encoded intentions comprising 4 related and 4 unrelated cue-action pairs. They were instructed to remember to perform these actions in response to cue words presented during a second semantic categorization task 12h later that encompassed either daytime wake (09:00-21:00) or overnight sleep with polysomnography (21:00-09:00).
Results: The significant condition x age group x relatedness interaction suggested that the sleep benefit on PM intentions varied according to age group and relatedness ($p=0.01$). For related intentions, sleep relative to wake benefitted young adults' performance ($p<0.001$) but not older adults ($p=0.30$). For unrelated intentions, sleep did not improve PM for either age group. While post-encoding N3 was significantly associated with related intentions' execution in young adults ($r=0.43$, $p=0.02$), this relationship was not found for older adults ($r=-0.07$, $p=0.763$).
Conclusion: The age-related impairment of sleep-dependent memory consolidation extends to prospective memory. Our findings add to an existing body of work suggesting that the link between sleep and memory is functionally weakened in older adulthood.
Support (if any): This work was supported by the National Medical Research Council, Singapore (NMRC/STaR/015/2013) and the National Research Foundation, Singapore (NRF2016_SOL002).

047

FEAR-POTENTIATED STARTLE AND SLEEP IN TRAUMA-EXPOSED MEN AND WOMEN WITH AND WITHOUT PTSD

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Introduction: Animal and human studies indicate that fear conditioning disrupts subsequent sleep, including REM sleep (REMS). REMS is thought to be central to fear information processing. We utilized an afternoon nap protocol to examine the effects of fear-potentiated startle (FPS), a variant of fear conditioning, on subsequent sleep integrity and REMS in trauma-exposed participants with varying levels of PTSD. We also examined the effects of changes in sleep integrity and REMS on subsequent retention and extinction of pre-sleep learning.
Methods: Participants (N=47) participated in 3 nap visits. The first was an adaptation nap. The second and third nap visits were counterbalanced: a stress-condition nap, during which participants underwent FPS procedures prior to a nap and assessment of retention of fear and safety signal learning and fear extinction after the nap, and a control visit during which participants had a nap opportunity without stressful procedures. Canonical correlation analysis assessed the relationship between FPS responses and change in subsequent sleep relative to a control nap, as well as the relationship between change in sleep from control to stress condition and both subsequent fear and safety learning retention, and subsequent extinction.
Results: Results demonstrated a relationship between fear learning and change in sleep and supported a relationship between safety signal learning and subsequent REMS, as well as differential conditioning and wake after sleep onset. Sleep did not predict measures of fear retention or extinction. PTSD symptoms did not predict fear learning or sleep measures.
Conclusion: These findings replicate prior work showing a relationship between safety learning and REMS, suggesting that this is a core mechanism through which stress impacts fear processing. Further research is critical to further understand this effect, and to examine how different aspects of fear learning impact different components of sleep. This study also demonstrates that nap studies can be a valuable approach for studying the stress-sleep relationship.
Support (if any): VA Career Development Award to Dr. Richards (5IK2CX000871-05)

048

INCREASED COGNITIVE LOAD UNDER STRESS MODULATES SLEEP SPINDLES AND SLOW OSCILLATIONS IN A SLEEP-STAGE DEPENDENT MANNER

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Introduction: The effect of increased cognitive load especially under duress has been known to affect brain rhythms in humans. However, this effect has been shown primarily in the awake brain; the effect of stressful cognitive load on sleep rhythms is yet unclear. We leveraged a unique opportunity to understand the effect of cognitive load under laboratory stress on sleep spindles and slow oscillations that are hallmark rhythms of NREM sleep.
Methods: Cortical 6-channel EEG nap data were collected from 45 subjects over two separate days: after a control session without laboratory stressors and after an experimental session in which they underwent fear condiitoning and negative-emotional-image viewing sessions. We detected sleep spindles (11-13Hz over frontal regions and 13-16Hz over centroposterior regions) and slow oscillations (0.16–1.25Hz oscillations) as discrete events at each of the six electrodes, and staged them by the sleep hypnogram. We evaluated the spindle rate in N2 sleep and the proportion of slow oscillations nested with a spindle in N3 sleep.
Results: Over all 6 EEG electrodes, N2 spindle rates increased on average by 14% in the experimental session compared to the control session (mixed-effect models $p<0.001$). In addition, over all 6 electrodes, the proportion of slow oscillations in N3 nested with a spindle increased by 2.3% in the experimental session compared to the control session (mixed effect model, $p=0.005$).
Conclusion: We show for the first time how increased cognitive load under stressful laboratory conditions affects sleep rhythms. Such an increased response in sleep might correspond to a continued emotional response due to the cognitive load under duress. Ongoing work seeks to tie these findings to possible emotional memory consolidation.
Support (if any): VA Career Development Award to Dr. Richards (5IK2CX000871-05)

049

THE EFFECT OF OBSTRUCTIVE SLEEP APNEA ON EMOTIONAL MEMORY CONSOLIDATION

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Introduction: A growing body of evidence suggests that sleep is critical for the processing and consolidation of emotional information into long-term memory. Previous research has indicated that emotional components of scenes particularly benefit from sleep in healthy groups, yet sleep dependent emotional memory processes remain unexplored in many clinical cohorts, including those with obstructive sleep apnea (OSA).
Methods: In this study, a group of newly diagnosed OSA patients (n=26) and a matched group of healthy controls (n=24) encoded scenes with negative or neutral foreground objects placed on neutral backgrounds prior to a night of polysomnographically recorded sleep. In the morning, they completed a recognition test in which objects and backgrounds were presented separately and one at a time.
Results: OSA patients have a deficit in both overall gist memory and the specific recognition memory for the scenes. Impairment of gist recognition was across all elements of the scenes, both negative and neutral objects and backgrounds [main effect of group: $F(1,48) = 13.5$, $p=0.001$], while specific recognition impairment was exclusively found for negative objects [$t(48)=2.0$, $p=0.05$]. Across all participants, successful gist recognition correlated positively with sleep efficiency ($p=0.001$) and REM sleep ($p=0.009$), while successful specific memory recognition correlated only with REM sleep ($p=0.004$).
Conclusion: Our findings indicate that fragmented sleep and reduced REM sleep, both hallmarks of OSA, significantly disrupt distinct memory processes for emotional content. Gist memory is universally impacted, while memory for specific details appears to have a greater deterioration for negative aspects of memories. These memory affects may have impacts on complex emotional processes, such as emotion regulation, and could contribute to the high comorbid depressive symptoms in OSA.
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050

EVENING ALCOHOL CONSUMPTION AND SLOW WAVE SLEEP: IMPACT ON MORNING HIPPOCAMPUS-DEPENDENT LEARNING ACROSS THREE NIGHTS

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Introduction: Numerous studies interrogated the relationship between alcohol and a single night of sleep. Yet, many adults engage in cumulative days of drinking. Previous studies show alcohol on a single night increases slow wave sleep in the first third of night. Similarly, sleep has been associated with the success of daytime learning. Our goal was to investigate across three consecutive nights how evening alcohol use and nighttime sleep are associated with morning learning.
Methods: 23 adults (11F, mean age 33.5±12 years) completed six nights of PSG monitored sleep. Participants consumed alcohol with a target 0.08 breath alcohol concentration (BrAC) and no alcohol on three consecutive nights in counterbalanced order. Percent of slow wave sleep (SWS%) in the first third of the night was derived. Learning was assessed each morning with distinct stimuli on the Mnemonic Similarity Task (MST). The MST score derived was the Lure Discrimination Index (LDI), defined as the proportion of similar images correctly identified minus the proportion of old images incorrectly identified.
Results: SWS% during the first third of the night was greater for alcohol nights compared to non-alcohol nights ($F(1, 110)=10.891$, $p=0.01$). However, there was no evidence that either night number or the interaction of drink content and night number affected %SWS in the first third of night (all p's > 0.05). There was a modest decrease in LDI on mornings following alcohol consumption; however, this effect was not significant. In a separate linear mixed-effect model we found no evidence for an effect of night number, drink content, or their interaction on MST LDI scores (all p's > 0.05).
Conclusion: Our results indicate that slow wave sleep in the first third of the night is sensitive to evening alcohol consumption. Despite prior literature associating slow wave sleep with next-day learning, we observed no effect of alcohol or night number on morning learning. It is possible that the small sample size contributed to our results. There is little prior research on the cumulative effects of alcohol on sleep and learning; our study adds to this area of research despite the negative findings.
Support (if any): R01AA025593

051

IS WORKING MEMORY ASSOCIATED WITH AG- RELATED EMOTIONAL MEMORY BIAS?

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Introduction: Aging is accompanied by deterioration in both working memory (WM) and long-term memory (LTM), though the reason is not well understood. Sleep may play a role in young adults, but the findings in older adults are not as clear. In addition, older adults show better memory for positive memories, whereas youngers tend to hold on to negative memories. The prefrontal cortex has been implicated in this emotional memory bias. The current study investigated the role of working memory (a prefrontal task) on emotional memory consolidation across sleep and wake in young and older adults.
Methods: In the morning, 93 younger (18–39) and 121 older (60–85) adults took a WM task and encoded neutral or negative word pairs, and gave valence and arousal ratings for each pair. After a wake or polysomnography-recorded sleep condition, memory for the word pairs was tested plus valence and arousal ratings.
Results: Youngers had better overall memory ($p<.001$), with older adults showing better memory for neutral compared to negative word pairs ($p=.04$), as well as increased positivity ($p=.02$), which was correlated with LTM performance ($p=.009$). In contrast, youngers performed better on the negative word pairs ($p=.01$), but no change in ratings and no association between emotional reactivity and LTM. Further, WM was positively related to memory in youngers ($r=.38$, $p=.02$), but not in older adults. Lastly, no role for sleep likely due to the lack of an immediate test.

Conclusion: we found that the positivity bias in aging in both memory and valence, with increasing positivity associated with better memory. We found a robust relation between WM and LTM in youngers but not older adults. Our findings are consistent with the socioemotional-selectivity theory that posits that aging is associated with a relative suppression of negative information while WM may play a role.
Support (if any):

052

APOE-E4 IS ASSOCIATED WITH IMPAIRED SLEEP-DEPENDENT MEMORY CONSOLIDATION IN HEALTHY CARRIERS

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Introduction: The Apolipoprotein E (APOE)-ε4 genotype is a marker of susceptibility for late-onset Alzheimer's disease (AD). Sleep disturbances may accelerate the aging process and increase the risk for future development of cognitive impairment and dementia. Given that the pathophysiological process of AD can predate its clinical manifestations by years or even decades, the aim of this study was to assess the role of the APOε4 allele on sleep-dependent memory consolidation in cognitively healthy adults.
Methods: 16 healthy APOE-ε4 carriers (mean age=49.9±13.7) and 32 healthy non-carriers (age=45.7±12.9) were included in the main analysis. Baseline screening included the Epworth Sleepiness Scale, Morningness-Eveningness scale, Wechsler Adult Intelligence Scale (WAIS) and Beck Depression Inventory (BDI), as well as a baseline polysomnogram (PSG), which also served as an adaptation night. Participants subsequently underwent an overnight testing session, which included computer sessions of the Psychomotor Vigilance Task (PVT) and the declarative Verbal Paired-Associates Task (VPA) in the evening followed by a full night PSG and repeat PVT and VPA sessions in the morning. For further reference, we added an age matched group of 16 non-carriers with newly diagnosed obstructive sleep apnea (OSA, age=48.1±15.1), who underwent the same study procedures.
Results: APOE-ε4 carriers had higher BDI (p=0.04) and ESS (p=0.01) scores than non-carriers. There were no significant group differences for sleep macrostructure. Evening VPA performance was similar for both groups (p=0.77). The following morning, APOE-ε4 carriers improved by 7.5±6.4 % from the evening before, compared to 13.5±7.0% for the healthy non-carriers (p=0.005). OSA subjects improved by 5.0± 8.1%, which was similar to APOE-ε4 carriers (p=0.34).
Conclusion: To our knowledge, this is the first study to reveal that healthy APOE-ε4 carriers while showing similar initial learning (encoding) on a declarative memory task compared to healthy controls, exhibit a deficit in sleep-dependent memory consolidation, similar to patients with obstructive sleep apnea. Consequently, this study provides evidence that impaired sleep-related memory processes could be an important harbinger in otherwise healthy individuals, who are at high risk for AD.
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053

REM SLEEP APNEA SEVERITY CONTRIBUTES TO POOR VERBAL MEMORY IN COGNITIVELY ASYMPTOMATIC OLDER ADULTS

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Introduction: The prevalence of obstructive sleep apnea (OSA) rises with age, leading to increased dementia risk and memory decline. However, it remains unclear which OSA features drive this relationship. Here, we examine associations between verbal memory and multiple OSA features in healthy older adults.
Methods: 58 cognitively asymptomatic adults (61.4±6.3 years; 38 females) underwent polysomnography (PSG) and the Rey Auditory Verbal Learning Test (RAVLT; 0.2±0.5 years between assessments). OSA measures included apnea-hypopnea index (AHI), respiratory disturbance index (RDI), and desaturation index in both NREM and REM sleep. RAVLT measures included total learning (sum of trials 1–5), short-delayed recall, and long-delayed recall. Pearson correlations with FDR correction were calculated between OSA-related measures and RAVLT. Multiple regression was then used to adjust for OSA features in other sleep stages (i.e., REM versus NREM), age, sex, time between PSG and neuropsychological assessments, years of education, and APOE4 status. We also explored whether age moderated these relationships.
Results: REM RDI is negatively associated with RAVLT total learning ($r=-0.31$, $p<0.01$ with age moderating the effect at 1SD above mean: $B=-0.22$, $t(49)=-2.88$, $p=0.01$) and RAVLT long-delayed recall ($r=-0.36$, $p<0.001$; with age moderating the effect at mean: $B=-0.05$, $t(49)=-2.38$, $p=0.02$; and moderating at 1SD above mean: $B=-0.09$, $t(49)=-3.91$, $p<0.01$). REM desaturation index was also associated with RAVLT total learning ($r=-0.21$, $p<0.01$) and RAVLT long-delayed recall ($r=-0.34$, $p<0.01$). REM AHI was negatively correlated to RAVLT long-delayed recall ($r=-0.34$, $p<0.01$; with age significantly moderating the effect at the mean: $B=-0.06$, $t(49)=-2.87$, $p=0.01$; and moderating at 1SD above the mean: $B=-0.11$, $t(49)=-4.23$, $p<0.01$). Of note, NREM OSA features were not significantly correlated to RAVLT measures when REM OSA features were included in the model.
Conclusion: These findings demonstrate that REM OSA features in particular contribute to poor verbal memory encoding and retrieval, especially at older ages. Verbal memory decline has been predictive of conversion to Alzheimer's disease (AD). Future studies including brain imaging, AD biomarkers, REM sleep oscillations, and comprehensive neuropsychological testing may elucidate the underlying mechanisms linking REM OSA features to memory decline and dementia risk.
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CHARACTERIZATION OF SLEEP PHENOTYPES AND SLEEP-DEPENDENT MEMORY CONSOLIDATION IN A MOUSE MODEL OF FRAGILE X SYNDROME

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Introduction: Fragile X syndrome (FXS) is a neurodevelopmental disorder caused by disruption of Fmr1 gene function, leading to intellectual disability. FXS individuals report increased incidence of sleep disruptions such as loss of NREM sleep, irregular sleep/wake cycles, and circadian rhythm disturbances that warrant pharmacological intervention. Since sleep has critical roles in the promotion of memory consolidation, it is unknown whether disrupted cognitive function in FXS is exacerbated by abnormal sleep. We characterized the link

between sleep loss phenotypes and cognition in FXS mice (Fmr1 KO). We hypothesized that normalizing sleep in Fmr1 KO mice could improve sleep-dependent cognitive function. Because direct activation of G-protein inward rectifying potassium (GIRK) channels by ML297 has been found to promote NREM sleep, we tested how ML297 affected sleep and memory consolidation phenotypes in Fmr1 KO mice.
Methods: Wild type (WT) and Fmr1 KO were implanted with electrodes for electroencephalogram/electromyogram (EEG/EMG) recording of wakefulness, NREM and REM sleep. Sleep-dependent memory consolidation was measured using single-trial contextual fear conditioning (CFC). ML297 or vehicle was administered after CFC training to measure the effects on sleep and fear memory consolidation.
Results: Fmr1 KO mice showed reduced sleep in the hours following CFC learning compared to wild type littermates, and reduced contextual fear memory consolidation. Post-CFC sleep deprivation disrupted memory consolidation in wild type littermates, but not Fmr1 KO mice. Both NREM sleep time and NREM bout length were reduced in Fmr1 KO mice, and preliminary data suggest reduced NREM delta (0.5–4 Hz) power in the prefrontal cortex. These deficits were present at baseline and also following CFC. Post-CFC training administration of ML297 rescued NREM sleep and contextual fear memory deficits in Fmr1 KO mice.
Conclusion: Our study showed a strong link between NREM sleep loss and cognitive deficits in Fmr1 KO mice. Critically, normalization of NREM sleep through direct activation of GIRK channels rescues cognitive deficits seen in Fmr1 KO mice, suggesting a new therapeutic approach to treating cognitive deficits associated with FXS.
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055

NOVEL SLEEP-DEPENDENT SPATIAL MEMORY AND NAVIGATION TASK USING MINECRAFT

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Introduction: Spatial navigation and memory are hippocampally-dependent and decrease with age, yet, ecologically-valid methods remain elusive. We developed an engaging and inherently flexible spatial navigation/memory task using the Minecraft platform to test sleep-dependent memory. We validated baseline performance and learning rates across two separate Minecraft environments.
Methods: Using a within-subjects design, twenty-two subjects experienced two conditions (wake/sleep) and two Minecraft environments, counterbalanced across subjects. At encoding, subjects learned the locations of 12 objects. Memory for object location accuracy and navigation route (distance between start and target; vector: angle of direction towards target location from start) was tested immediately and following 12-hours of wake or sleep. Post-hoc analyses were conducted using a median split on subjects' Immediate test performance.
Results: There were no significant differences across conditions for the Immediate test performance ($t(22) = .567$, $p = .576$) across the two environments. Delayed test showed greater improvement in accuracy after sleep compared to wake ($t(18) = 2.795$, $p=.012$), no differences in distance or vector. Median split by Immediate test performance revealed that initially lower performance showed the greatest improvement after delay in the sleep group ($t(18) = 2.818$, $p =.011$), but not the wake group ($t(18) = -1.051$, $p =.308$). Additionally, these same subjects' vector direction was initially worse at Immediate Test ($t(18) = -2.9$, $p = .01$), and improved with sleep, becoming equivalent to the better performers at Delay test ($t(18) = -.336$, $p = .74$).
Conclusion: We demonstrate a novel spatial navigation/memory tasks using Minecraft that shows sleep-dependent learning across two distinct environments. We showed enhancement of spatial location accuracy after a night of sleep compared to wake. We further demonstrate that with sleep, those with worse initial performance show the greatest memory and navigation improvement, consistent with other findings that sleep supports enhancement of weaker memories and extended to the spatial-domain. This novel platform can be used to evaluate spatial memory across the lifespan and within special clinical populations.
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056

EFFECTS OF SIMULATED SHIFT SCHEDULES ON VISUAL SEARCH

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Introduction: Visual search is important in many operational tasks, such as passive sonar monitoring in naval operations. Shift work can contribute to fatigue and task performance impairment; in particular, backward rotating shift schedules have been shown to impair vigilant attention performance. However, the impact on visual search performance, above and beyond impaired vigilant attention, is unknown. We investigated the effects of two distinct shift work schedules using a visual search task with properties of real-life visual search performance.
Methods: N=13 adult males (ages 18–39) completed a 6-day/5-night laboratory study with an acclimation day, four simulated shift days, and a recovery day. Shift days involved either a 5h-on/15h-off backward rotating schedule (n=8) or a 3h-on/9h-off fixed schedule (n=5). The visual search task was performed once per shift at varying time of day depending on shift. Participants viewed search arrays where stimuli consisted of colored letters of different shapes. Over three trial blocks of 24 trials each, participants determined if a target was present or absent among 1, 5, 15, or 30 distractors. Similarity between targets and distractors was manipulated between blocks, such that targets differed from distractors by color only, shape only, or either color or shape but not both. For each distinct target feature block, and separately for presence or absence of a target, slopes of response times regressed against number of stimuli were calculated to quantify visual search rates. Mixed-effects ANOVA was used to analyze visual search rates by shift schedule and shift day.
Results: There were no significant effects of shift schedule (all $p>0.30$), shift day (all $p>0.13$), or their interaction (all $p>0.22$) on visual search rates.
Conclusion: Previous work showed degraded vigilant attention in the shift schedules considered here, especially in the backward rotating schedule, which may compromise operational performance. However, while our sample may have been too small to have adequate statistical power, we failed to identify specific impairments in visual search with statistical significance. It remains to be determined whether greater levels of fatigue, such as could be induced by total sleep deprivation, would reveal significant visual search deficits.

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057

AGE-RELATED CHANGES IN SLEEP IMPACT LEARNING-RELATED FUNCTIONAL CONNECTIVITY IN THE CORTICO-STRIATAL-HIPPOCAMPAL SYSTEM

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Introduction: Older adults do not consolidate newly learned motor sequences with the same efficiency compared to younger adults, and there is evidence that enhanced consolidation by sleep is also impaired with age. It is known that brain activity in the hippocampal-cortical-striatal network is important for off-line consolidation of motor-sequences, however, the intricacies of how communication within this network is altered by sleep in order to facilitate consolidation is not known.

Methods: In this study, 37 young and 49 older individuals underwent resting state MRI before training on a MSL task, as well as after training, and then once again, after either a nap or a period of awake rest.

Results: Preliminary analysis showed a significant difference in functional communication (FC) in the hippocampal-cortical-striatal network, with younger subjects showing increased FC compared to younger individuals. Follow-up analyses revealed this effect was driven by younger subjects who showed an increase in FC between striatum and motor cortices, as well as older subjects who showed decreased FC between hippocampus, striatum, and precuneus. Therefore, an opposite effect of sleep was observed in younger vs. older participants, where young participants primarily showed increased communication in the striatal-motor network and older participants showed decrease in key nodes of the default mode network.

Conclusion: This shows that changes to sleeps' ability to optimize functional communication may disrupt sleep-enhanced MSL consolidation in old age.

Support (if any): Canadian Institutes of Health Research

058

THE INTERACTIONS OF SLEEP, HEART RATE VARIABILITY AND AGING ON AN EMOTIONAL DIRECTED FORGETTING MEMORY TASK

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Introduction: The ability to forget information plays an important role in our daily lives. Sleep plays a role in memory formation and as we age, sleep-quality and memory decrease. For emotional memory a drop in preference for negative stimuli is presented with aging. Heart-rate variability (HRV), a measurement of cardiac autonomic-activity, has been related to cognitive processes. It is unknown how HRV impacts sleep-dependent memory updates in older adults. Here, we investigated HRV and sleep-related emotional memory updates in the context of aging using a Directed-Forgetting (DF) paradigm.

Methods: We tested younger [N=105,18-25yr] and older adults [N=119,60-85yr]. Subjects encoded a DF Word-Paired task, in which either negatively/neutrally-valenced word-pairs were cued to-be-remembered (Retain) or forgotten (Alter) for a later test. They then took a polysomnographically-recorded (PSG) nap including HRV. Next, recognition was tested. Memory for both Retain and Alter words was measured. We compared memory, sleep-quality measured by Sleep-Efficiency (SE) and HRV, measured by normalized High-Frequency (HFnu), an indicator of parasympathetic activity. Bivariate correlations were used to measure the associations.

Results: Younger adults showed greater performance on both Retain and Alter word-pairs ($p<.001$) with being able to better forget Alter word-pairs only for the negative-condition ($p<.001$). Younger adults had a higher SE ($p<.001$) and a higher HRV-HFnu in both Stage2 ($p=.02$) and Stage3 ($p=.03$). Only for older adults in the neutral-condition, we found correlations between memory and sleep [Retain: $r(20)=.52$, $p=.01$; Alter: $r(20)=.51$, $p=.01$]. Finally, among younger adults, in Stage 2, memory was related to HFnu for both neutral [Retain: $r(17)=.46$, $p=.05$] and negative-condition [Retain: $r(25)=-.41$, $p=.03$; Alter: $r(25)=-.39$, $p=.05$]. No correlations were found for older adults(all ps>.11).

Conclusion: Our result indicate a possible loss of the ability to intentionally forget irrelevant information among older adults and a role for the saliency to forget irrelevant items among younger adults. In addition, aging brain may benefit from sleep only for the neutrally-valenced items; the memory biased seen in aging. Finally, for younger adults HRV may be related to memory updates and its role depends on specific sleep stages however this association is faded away with aging.

Support (if any):

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DARIDOREXANT: A DUAL, EQUIPOTENT, AND INSURMOUNTABLE ANTAGONIST OF BOTH OREXIN-1 AND OREXIN-2 RECEPTORS

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Introduction: The orexin neuropeptide–receptor system is a central sleep and wake regulator in the brain. The two orexin receptor subtypes, OX1R and OX2R, are expressed either alone or together in all major wake-promoting brain areas. OX1R and OX2R activation by orexins causes elevation of intracellular calcium, which enhances synaptic transmission in secondary, monoaminergic wake- and arousal-promoting neurotransmitter circuits. Orexin receptor antagonists represent a novel and specific treatment of insomnia, which is different from classical therapy that more broadly inhibits brain activity via GABAA activation. Here we describe the molecular pharmacology of daridorexant, an orexin receptor antagonist which has proven highly effective in improving sleep and daytime functioning in insomnia patients.
Methods: Orexin-A(OxA)-induced calcium release assays in OX1R- and OX2R-expressing recombinant cell lines were applied to measure the antagonistic potency and kinetic properties of daridorexant in functional assays. Whole-cell competitive binding assays, using an orthosteric tracer were employed to determine the Ki of daridorexant. Comparisons were made with suvorexant and lemborexant.
Results: In OxA-induced calcium release assays with 2-h pre-incubation time, daridorexant displayed apparent Kb values of 0.5 nM (OX1R) and 0.8 nM (OX2R) with insurmountable antagonism on both receptors, demonstrating equipotent and highly effective functional inhibition of both receptor subtypes. On-target residence times of daridorexant (37oC) expressed as receptor occupancy half-lives (ROt1/2) were 4 min (OX1R) and 8 min (OX2R). In binding assays, daridorexant behaved as highly potent orthosteric antagonist. Also suvorexant behaved as dual insurmountable antagonist at OX1R/OX2R (appKb=0.7nM/1.0nM; ROt1/2=9 min/6 min) and as potent orthosteric antagonist in binding assays. Interestingly, lemborexant displayed a different interaction profile at OX1R/OX2R (appKb=13nM/0.4nM, ROt1/2<2min/<2min), i.e. it behaved as preferential OX2R antagonist with a very short on-target residence time and little insurmountability.
Conclusion: Daridorexant displays the desired target interaction profile of a dual, equipotent, and insurmountable antagonist of both OX1R and OX2R, which ensures equally efficient inhibition of both arousal-/wake-promoting receptor subtypes. Daridorexant´s on-target residence times are long enough to cause insurmountable inhibition, but short enough to avoid pharmacodynamic effects after drug elimination.
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CHALLENGING THE CURRENT ASSESSMENT CRITERIA FOR SCORING CENTRAL SLEEP APNEA AT ALTITUDE

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Introduction: Sleep disordered breathing comes in two forms: obstructive and central sleep apnea (SA). Obstructive sleep apnea (OSA) is caused by upper airway collapse during sleep, and is associated with increases in morbidity and mortality. Conversely, central sleep apnea (CSA) results from increases in respiratory chemosensitivity to blood gas challenges in the context of high-altitude ascent. CSA increases in severity and apneas shorten in duration with higher ascent and/or time spent at altitude. Although both types of SA are characterized by intermittent periods of apnea and hyperventilation, the underlying mechanisms and phenotypes between OSA and CSA are different. A universal scoring system for the two types of context-dependent SA may lead to errors in quantification. The American Association of Sleep Medicine (AASM) developed assessment criteria for SA, which are universally-utilized for all types of SA to quantify an apnea-hypopnea index (AHI; events/hour), where apneas are scored as cessation of breathing ≥10-sec. We aimed to assess the effect of reducing the apnea-detection threshold (ADT) to <10-sec to quantitatively assess the extent that a shorter ADT affects the scoring of AHI in the context of high-altitude ascent, where CSA is universal.
Methods: We assessed CSA using portable polysomnography (ApneaLink, ResMed) during ascent to 5160m in the Nepal Himalaya over 10 days in 15 healthy participants. Files were archived digitally for later analysis using automated scoring software (ApneaLink Reporting Software, ResMed). We quantified and compared AHI using AASM criteria (i.e., 10-sec ADT) and a shorter 5-sec ADT.
Results: AHI was 3.9±4.1 events/hour at 1045m prior to ascent, with AHI increasing to 37.5±32.8 events/hour (P<0.0001) at 5160m after 10 days of incremental ascent using AASM criteria (i.e., 10-sec ADT). When the ADT was reduced to 5-sec at 5160m, AHI was increased to 61.6±38.1 (+61%; P=0.0002).
Conclusion: This preliminary report suggests that the AASM criterion for scoring apneas, which is broadly applied to OSA at low altitude, may underestimate the assessment and quantification of CSA with ascent to and prolonged stays at high altitude. Development of distinct assessment criteria for OSA and CSA may be warranted.
Support (if any): Natural Science sand Engineering Research Council of Canada

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SLEEP HYGIENE AS AN INTERVENTION TO LOWER BLOOD PRESSURE

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Introduction: Insufficient sleep has been shown to increase the risk of a person developing hypertension. Impaired baroreflex sensitivity (BRS) is one of the known underlying mechanisms involved that is responsible for increasing blood pressure (BP). This project investigates the relationship between sleep, BRS, and BP during Valsalva's Maneuver (VM).
Methods: Fifty participants (59.8 ± 1.5 years; 31 women) completed 3 overnight in-hospital stays. The first stay (S1) was a baseline control; the second stay (S2) followed a 4-week wait-list control condition; the third stay (S3) followed an 8-week randomly assigned intervention that used sleep hygiene approaches and scheduling to either A) stabilize sleep timing, or B) stabilize and extend the bed period. The study is still ongoing, and we are blind to whether participants were randomized to arm A or B of the study. A linear regression model analyzing the R-R Interval (RRI) and corresponding systolic BP was used to calculate the BRS function and the maximum change in SBP (BPMax) during Early Phase II (EPII) of VM.
Results: There was an increasing BRS trend across the three stays during EPII (p=.051). There was no significant increase between S1

and S2 (p=.876), but BRS significantly increased following 8 weeks of intervention at S3 compared to S1 (p=0.033) and S2 (p=0.037). There was also a significant decrease in BPMax across the three stays during EPII (p<.001). There was no significant decrease in EPII BPMax between S1 and S2 (p=.325), but BPMax significantly decreased in S3 compared to S1 (p<0.001) and S2 (p=0.002).
Conclusion: While we are still blind to condition, both conditions are considered active as they both involve stabilizing the sleep period using sleep hygiene. These preliminary data suggest that stabilization of sleep timing and possibly duration, has a positive impact on BP regulation.
Support (if any): NIH (R01HL125379 to Dr. Janet Mullington), Harvard Catalyst, Harvard Clinical and Translational Science Center (UL1TR001102).

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SEX DIFFERENCES IN SLOW WAVE SLEEP FOLLOWING EVENING BINGE ALCOHOL CONSUMPTION
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Introduction: Binge alcohol consumption alters normal sleep architecture, often via increased slow wave sleep (SWS) and decreased rapid eye movement (REM) sleep. Women may be more susceptible to the sedative effects of alcohol during blood alcohol content (BAC) decrease as they report higher subjective sleepiness scores prior to bedtime. The purpose of the present study was to examine changes in SWS between men and women following binge alcohol consumption and determine the relation between BAC change at lights out and subsequent sleep architecture.
Methods: Twenty-three participants (11 men, 12 women) between the ages of 21–45 years were tested twice, once after evening binge alcohol consumption and once after fluid control (randomized, crossover design). The alcohol dose was based on body weight and sex (1g/kg in men, 0.85g/kg in women) and served as a 4–5 drink equivalent consumed over two hours. Breath alcohol content (BrAC) was monitored in 15-minute increments from first drink consumption to lights out. Overnight polysomnography (PSG) was recorded in each individual and scored by a board-certified sleep physician. Statistical analysis consisted of repeated measures ANOVA and Pearson correlation (p>0.05).
Results: Age (24±4 vs. 26±6 years) and BMI (27±4 vs. 27±4 kg/m2) were similar between men and women. Peak BrAC (0.10±0.02% vs. 0.10±0.02%) and percent change (-19±11% vs. -19±11%) in BrAC from peak to lights out were also similar between the sexes. Peak BrAC was significantly correlated to the percentage of SWS in women (r=-0.71; p=0.01), but not men (r=-0.25; p=0.45). Similarly, the percent change in BrAC from peak to lights out was significantly correlated to the percentage of SWS in women (r=-0.66; p=0.02), but not men (r=-0.40; p=0.22). The SWS and REM latencies were not associated with either peak or lights out BrAC in both men and women.
Conclusion: Peak BrAC, and the rate of BrAC clearance prior to lights out, appear to impact SWS differently in men and women. Specifically, women appear to have more SWS in response to high BrAC than their male counterparts, suggesting a stronger depressor impact with regards to SWS in women.
Support (if any): National Institutes of Health (AA-024892; U54GM115371; P20GM103474).

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DIFFERENTIAL IMPACT OF SLEEP DURATION ON NOCTURNAL BLOOD PRESSURE DIPPING BETWEEN MEN AND WOMEN
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Introduction: There is growing evidence that poor sleep may have a greater impact on the development of cardiovascular complications in women compared to men. However, most studies that have evaluated the impact of sex on sleep insufficiencies and blood pressure (BP) have not utilized ambulatory BP, and often rely more heavily on subjective sleep diaries as opposed to objective sleep assessment. The purpose of this study was to examine the impact of sex on the relationship between objectively measured sleep and nocturnal BP dipping. We hypothesized that poor sleep would be associated with decreased nocturnal BP dipping, and that this association would be stronger in women.
Methods: Total sleep time (TST) and sleep efficiency (SE) were monitored in fifty adults (31 men, 19 women; 36±3 years; 26±1 kg/m2) utilizing wrist actigraphy monitoring over the course of 5–14 days (Avg: 10±0 days). On a separate occasion, participants underwent a 24-hour ambulatory BP recording session. Independent samples T-tests were used to compare characteristics between sexes. Partial correlations controlling for age and BMI were utilized to probe relationships between sleep and nocturnal BP dipping.
Results: TST and SE were not different between sexes. However, women exhibited reduced mean arterial pressure (MAP: 86±1 vs. 90±1 mmHg, P=0.026) compared to men. Partial correlation revealed a significant relationship between TST and the magnitude of nocturnal MAP dipping in the sample population (R = 0.460, P<0.001). When stratified by sex, this significant relationship persisted in men (R = 0.610, P<0.001), but not women (R = 0.108, P>0.05). In contrast, no relationship was observed between SE and nocturnal MAP dipping (R = -0.052, P>0.05) for the sample population. Similarly, SE did not correlate with nocturnal MAP dipping in men (R = -0.080, P>0.05) or women (R = 0.045, P>0.05).
Conclusion: Contrary to our initial hypothesis, our results demonstrate that actigraphy-based TST is associated with nocturnal BP dipping in healthy men, but not women. This suggests a relation between impaired nocturnal BP regulation and habitual sleep duration, potentially predisposing men to an increased overall risk for cardiovascular complications.
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064
HIGHER RESTING HRV ENHANCES PROTECTIVE EFFECTS OF SELF-REPORTED RESILIENCE AGAINST THE IMPACT OF POOR SLEEP QUALITY ON PTSS
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Introduction: Poor sleep quality is a well-established risk for posttraumatic symptoms (PTSS; Casement et al., 2012; Germain et al., 2004; 2005). Conversely, self-reported resilience is a well-established protective factor against PTSS (Mealer et al., 2012; Wrenn et al., 2011) and has also been shown to moderate the negative impacts of stressful life events on sleep quality (Li et al., 2019). Fewer studies have

investigated whether autonomic indices of regulatory control moderate the impacts of resilience and sleep quality on PTSS. Resting heart rate variability (HRV) is a widely supported measure of top-down regulation of cognitive, behavioral and autonomic outcomes (Thayer & Ruiz-Padial, 2006). Higher HRV has been linked with increased capacity for stress coping as well as regulation of affect and attention (Bornstein & Suess, 2000). This study investigates whether resting HRV moderates the relationship between resilience, sleep quality, and PTSS.

Methods: Participants completed the PTSD Checklist for DSM-5 criteria (PCL-5), the Pittsburg Sleep Quality Index (PSQI), and the Connor-Davidson Resilience Scale (CD-RISC-10). A resting baseline assessment of electrocardiogram was used to derive resting-state HRV. Participants (N = 42; 86% women; 76% Caucasian) were recruited from college courses and the surrounding community.

Results: Individuals were grouped into higher and lower HRV. In the lower HRV group, resilience was not related to PTSS, but poorer sleep quality predicted higher PTSS severity (B=.79). Specific components of sleep quality that predicted PTSS in the lower HRV group were sleep disturbance (B=.38) and daytime dysfunction (B=.76). In the higher HRV group, greater resilience predicted lower PTSS severity (B=-.63), but sleep quality was not related to PTSS. Sleeping medication was the only component that predicted PTSS in the higher HRV group, such that less sleep medication was related to higher PTSS (B=-.751).

Conclusion: These findings suggest that higher HRV in combination with a self-perception of greater resilience are protective factors against PTSS as well as the effects of poorer sleep quality on PTSS. Resting HRV provides an index of regulatory control that may also be a physiological component of resilience.

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065

SLEEP AND GRAY MATTER VOLUME: THE ROLE OF PHYSIOLOGICAL AROUSAL

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Introduction: Insomnia is associated with increased arousal. Brain regions involved in chronic insomnia are diffuse and the potential interactive role of physiological arousal in the association between insomnia symptoms and neural regions is unknown. This study examined whether physiological arousal (heart rate variability, HRV) moderated the association between sleep and gray matter (GM) volume of frontal [dorsolateral prefrontal cortex (DLPFC), anterior cingulate cortex (ACC)] and temporal [right/left (R/L) hippocampus] regions in adults with comorbid chronic widespread pain and insomnia (CWPI).

Methods: Forty-seven adults with CWPI (Mage=46.00, SD=13.88, 89% women) completed two weeks of diaries measuring sleep onset latency (SOL), wake time after sleep onset (WASO) and total sleep time (TST). Resting HRV was assessed via Holter monitoring (5 minutes). Root mean squared standard deviation of successive normal-to-normal heartbeats (RMSDNN) was computed. T1-weighted magnetic resonance images were obtained, segmented and co-registered to MNI space. GM volumes (DLPFC, ACC, R/L hippocampus) were estimated (FSL). Multiple regressions examined whether SOL, WASO or TST were independently associated with or interacted with RMSDNN in their associations with GM volumes, controlling for age.

Results: SOL interacted with RMSDNN in its association with ACC (B=-4.60, SE=2.06, p=.03, R-squared=.06). Longer SOL was associated with lower ACC volume at highest RMSDNN (lowest arousal; B=-103.54, SE=42.82, p=.02), not average/lowest RMSDNN (highest arousal, ps>.05). TST interacted with RMSDNN in its association with R hippocampus (B=-.22, SE=.10, p=.04, R-squared=.07). Shorter TST was associated with lower R hippocampal volume at lowest RMSDNN (highest arousal; B=7.39, SE=2.29, p=.002) and average RMSDNN (B=4.18, SE=1.50, p=.008), not highest RMSDNN (lowest arousal; p=.64). There was a trending association between WASO and R hippocampus volume (B=-13.67, SE=7.28, p=.07).

Conclusion: In patients with CWPI and highest physiological arousal, achieving longer TST may be important in terms of associations with right hippocampus volume. Improving (reducing) SOL may only impact ACC volume in those with lower physiological arousal. Trends of association between longer WASO and reduced right hippocampus volume warrant follow-up in larger samples. Findings highlight the interactive role of physiological arousal (HRV) in the neural mechanisms associated with sleep in CWPI.

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066

NORADRENALINE AND ACETYLCHOLINE INHIBIT SLEEP-PROMOTING NEURONS OF VENTROLATERAL PREOPTIC AREA THROUGH A LOCAL GABAERGIC CIRCUIT

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Introduction: The ventrolateral preoptic (VLPO) nucleus is a key area involved in the initiation and maintenance of sleep. During wakefulness, sleep-promoting galanin neurons in the VLPO are directly inhibited by arousal signals including noradrenaline and acetylcholine. We have found that while these neurotransmitters directly inhibit VLPO galanin neurons, they also activate GABAergic neurons in the VLPO that do not express galanin. We propose that when activated by monoaminergic and cholinergic inputs, these local VLPO GABAergic neurons provide an additional inhibition of the VLPO galanin sleep-promoting neurons. We tested this model in brain slices in mice.

Methods: We studied VLPO galanin neurons in mouse brain slices using patch-clamp recordings. We recorded from fluorescently labeled VLPO galanin neurons following the injection of a cre-dependent AAV encoding for mCherry, into the VLPO of Gal-cre mice. For the optogenetic studies we expressed channelrhodopsin-2 (ChR-2) in VLPO VGAT neurons and mCherry in galanin neurons by injecting a flp-dependent and a cre-dependent AAV encoding respectively for ChR2 and mCherry into the VLPO of VGAT-flp::Gal-cre mice. We photo-stimulated local GABAergic neurons and recorded from labeled VLPO galanin neurons. Noradrenaline, carbachol and receptor antagonists were bath-applied.

Results: Noradrenaline and carbachol inhibited VLPO galanin neurons by alpha-2 and muscarinic receptors and these effects were maintained in the presence of tetrodotoxin (TTX) indicating, as previously proposed, a direct inhibitory effect of noradrenaline and carbachol on VLPO galanin neurons. In addition, both noradrenaline and carbachol increased the frequency of spontaneous inhibitory postsynaptic currents (sIPSCs) of VLPO galanin neurons, suggesting an additional inhibitory action on VLPO galanin neurons. Finally, optogenetic stimulation of local VLPO GABAergic neurons produced short latency, TTX-resistant, opto-evoked IPSCs in VLPO galanin neurons. Both noradrenaline and carbachol increased the amplitude of these opto-evoked IPSCs by the activation of alpha-1 and muscarinic receptors.

Conclusion: Our results demonstrate that noradrenaline and acetylcholine inhibit VLPO galanin neurons directly and indirectly. Both noradrenaline and acetylcholine increase GABAergic afferent inputs to VLPO galanin neurons by activating local GABAergic neurons. We propose that during wakefulness this feedforward inhibition provides additional inhibition of VLPO galanin sleep-promoting neurons.
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067

CAUSAL COMMUNICATION ACROSS THE ELECTRODE MANIFOLD DURING SLOW OSCILLATIONS

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Introduction: The slow oscillation (0.5-1Hz, SO) is the most studied sleep waveform and reflects sleep homeostasis and is crucial for memory consolidation. It is not clear how SO causally affects brain networks. We used the effective connectivity technique to investigate causal information flow across the electrode manifold during the SO.
Methods: Night sleep EEG signals of 59 adult participants were recorded and visually scored into five sleep stages. We used three EEG channels for each region including frontal, central, parietal, and occipital. SOs were detected automatically and signals from one second before to one second after the SO's troughs were used for estimating effective connectivity in SO and non-SO windows. Windowing technique and generalized partial directed coherence were employed to estimate causal information flow (CIF) between selected brain regions. The Linear mixed-effect (LME) method was used to model the peaks of the CIF based on different predictors including SO channel, source and sink of CIF, and distance between each of SO channel, source and sink regions.
Results: The results of CIF estimation showed two peaks of CIF about 250ms before and after the SO's trough, but no difference between CIF in SO's trough and non-SO windows. We found no effect of source and sink regions, and their distance on CIF (p-value > 0.05). However, distance between SO channel to source and sink region (p-value < 0.05) significantly predicted CIF. The coefficients of the LME model showed a direct effect of distance between SO channel to sink region and opposite effect of distance between SO channel to source region on CIF peaks.
Conclusion: The results showed there were significant changes of brain regions causal communication during SOs and these changes were affected by the distance of SO channel to sink and source region of CIF. Channels that are closer to the SO send more information and regions farther from the SO channel receive more information. Based on the results, we hypothesize that the SO brain networks are optimized to facilitate communication between regions that are far apart.
Support (if any):

068

MORNING CARDIOVASCULAR FUNCTION IN CHRONIC CANNABIS USERS AND HEALTHY CONTROLS

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Introduction: In the US cannabis is recreationally legal in 15 states and medically legal in 34 states. Preclinical studies suggest beneficial effects of cannabis on the cardiovascular system (e.g., vasorelaxation). Yet, acute cases of hospitalization after cannabis consumption indicate potential adverse cardiac effects. Vascular endothelial function is a marker of cardiovascular disease and is measured as a change in resting brachial artery diameter (flow-mediated dilation, FMD) during reactive hyperemia. Both resting diameter (positively) and FMD response (negatively) are associated with cardiovascular risk. Resting diameter likely depends on long-term structural changes, and FMD response mostly depends on nitric oxide. Reactive hyperemia is more complex and depends on numerous variables, including adenosine and prostaglandins. FMD is attenuated in the morning when the frequency of adverse cardiovascular events peaks. To begin to understand the effects of chronic cannabis use on the cardiovascular system, in this pilot study, we compared morning measurements of vascular endothelial function, blood pressure, and heart rate between chronic cannabis users and controls while controlling for prior nighttime sleep opportunities.
Methods: Participants, cannabis non-users (n=5) and users (n=4), 44% female, age 25.4 ± 3.6 years - no demographic differences between groups, kept a consistent 2-week sleep schedule at home followed by an 8h sleep opportunity at their habitual time in the laboratory. Upon-wakening, we measured resting blood pressure, heart rate, baseline diameter, hyperemic response, and FMD. Statistical differences between groups were calculated using a two-tailed t-test.
Results: Systolic and diastolic blood pressures (p=0.13 and 0.26 respectively), heart rate (p=0.97), and FMD response (p=0.99) did not differ between groups. However, chronic cannabis users had a significantly higher baseline brachial artery diameter (mean difference: 1.04 mm ± 0.26, p=0.005), and lower hyperemic response (mean difference: -7944 iu/s ± 2538, p=0.02) compared to non-users.
Conclusion: These preliminary findings suggest that chronic cannabis consumption may be associated with adverse structural and functional changes in the vasculature of otherwise healthy young adults. Based on these initial observations, cannabis may act on the cardiovascular system via non-nitric oxide mechanisms. However, it is necessary to increase our sample size to test the robustness of these findings.
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069

CHRONIC PAIN IN VETERANS WITH TBI IS ASSOCIATED WITH DECREASED EEG SLOW WAVE COHERENCE DURING NREM SLEEP

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Introduction: Chronic pain and sleep disturbances are intricately linked to one another, especially in individuals with a history of traumatic brain injury (TBI) who are at greater risk for both symptoms. Although prior studies have analyzed differences in sleep electroencephalogram (EEG) in these clinical populations, the association between sleep EEG slow wave coherence and pain complaints is not fully examined or known. Our novel slow wave coherence approach may provide new insights into the relationship between TBI, chronic pain, and sleep
Methods: Ninety-six veterans were recruited and enrolled under a VA IRB-approved protocol. Participants completed a semi-structured clinical interview to determine their history of TBI, Symptom Impact Questionnaire Revised (SIQR), a measure of chronic pain complaints, and underwent an attended overnight in-lab polysomnogram (PSG). We developed a novel computational signal processing algorithm to identify and quantify EEG slow waves within 100 ms bins across the 6 standard PSG EEG channels. When a slow wave was simultaneously observed in 4 or more of the 6 leads, slow wave coherence was

inferred, and a percentage of slow wave coherence across each of the sleep stages was then calculated for each subject.
Results: In our sample, 65 participants (67.7%) endorsed experiencing chronic pain lasting 3 months or longer, and 54 had a history of TBI (56.3%). Participants endorsing chronic pain had a significantly lowered percent of EEG slow wave coherence during NREM sleep than subjects without chronic pain ($p = 0.01$). NREM EEG slow wave coherence did not correlate with SIQR scores in subjects without TBI ($r = -0.03$, $p = 0.90$), but was significantly negatively correlated in subjects with TBI ($r = -0.32$, $p = 0.02$).
Conclusion: EEG slow wave coherence during NREM sleep is correlated with chronic pain complaints in Veterans with a history of TBI, and could be indicative of neuronal dysfunction during sleep. Further research on slow wave coherence is warranted to understand the underlying mechanisms for the association between chronic pain and poor sleep following TBI.
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070

RESPIRATORY, CARDIAC, EEG, BOLD SIGNALS AND FUNCTIONAL CONNECTIVITY OVER MULTIPLE MICROSLEEP EPISODES

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Introduction: Brief intrusions of unintended sleep can occur in various contexts, for example during resting-state fMRI scans. In addition to changes in neural activity, such microsleep episodes are also associated with shifts in respiration and heartrate. Here we investigated how these concurrent changes alter the dynamics of the BOLD signal in the brain and estimates of functional connectivity.
Methods: Ten participants underwent 6 runs of 20 minute resting-state fMRI scans with concurrent respiration, PPG and EEG recording. Realtime eye-closure monitoring combined with post eye-opening self-reports were used to identify microsleep episodes of different durations.
Results: During microsleep, sustained reductions were observed in arousal as assessed by EEG (ratio of alpha to delta and theta bands), as expected. In comparison, cortical BOLD signal exhibited more complex, temporally multiphasic changes which were consistent across different microsleep durations from 4 to 44s: (i) an initial sleep-onset dip reaching a nadir after ~6s, followed by (ii) an increase above wake baseline that plateaued till awakening. On awakening, (iii) a transient positive bump occurred up to 6s, followed by (iv) an undershoot below baseline lasting ~30s. While seen across the whole brain, these changes showed regional variations, e.g., the signal plateau in the thalamus remained below wake baseline. Sleep onset and awakening were also associated with respective reductions and increases in respiration and heart rate, which affect blood oxygen levels. Brain functional connectivity estimates were altered by the frequency of falling asleep, and this was not resolved by global signal regression.
Conclusion: Falling asleep and awakening are shown here to be associated with large, widespread BOLD signal changes consistent across varied durations of microsleep. These signal changes are intimately intertwined with shifts in respiration and heart rate, which are influenced by common brainstem nuclei controlling sleep. These autonomic contributions to 'brain signal' changes at microsleep onset and awakening are integral to sleep, and urge the integration of autonomic and central nervous system contributions to BOLD signal into frameworks for understanding brain function using fMRI. In addition, the correlation between frequency of microsleep and extent of altered functional connectivity highlight the need to minimize sleep during resting state scans.
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071

ACTIGRAPHY-DERIVED SLEEP METRICS ARE NOT RELATED TO CENTRAL HEMODYNAMICS OR ARTERIAL STIFFNESS IN HEALTHY ADULTS

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Introduction: Insufficient sleep is an emerging risk factor for cardiovascular disease. To evaluate the hypothesis that decrements in vascular function, due to poor sleep, may serve as a mechanistic link between sleep and cardiovascular disease, we explored relationships of actigraphy-derived sleep metrics with central hemodynamics and arterial stiffness in healthy young adults.
Methods: A total of 23 women and 27 men (23±5 yrs), free of known cardiovascular, metabolic, and renal disease, and not using sleep medication, participated in this study. ActiGraph GT9X wrist-worn accelerometers were used to measure sleep efficiency, total sleep time, wake after sleep onset, and number of awakenings over a seven-day period. Vascular health measures including central pressures and augmentation index at a heart rate of 75 beats per minute (AIx@75) were quantified via pulse wave analysis, and carotid femoral pulse wave velocity (cf-PWV) was assessed using applanation tonometry. Gender-specific z-scores for each of the sleep metrics were summed to assign each participant a "sleep score" (higher score = better sleep), and relationships between sleep scores and vascular health measures were explored using Pearson correlation coefficients.
Results: In men, sleep score (range: -4.92 to 9.10) was not related ($P>0.05$) to central systolic (114±15 mmHg, $r=-0.26$) or diastolic (72±7 mmHg, $r=-0.21$) pressures. Similarly, in women, sleep score (range: -5.02 to 5.34) was not related ($P>0.05$) to central systolic (103±11 mmHg, $r=-0.09$) or diastolic (72±10 mmHg, $r=-0.21$) pressures. Sleep score also failed to predict ($P>0.05$) indices of arterial stiffness, AIx@75 (men = 3.1±12.3, $r=0.04$; women = 5.2±9.5, $r=-0.25$) and cf-PWV (men = 6.2±0.8 m/s, $r=-0.12$; women = 5.7±0.5 m/s, $r=-0.10$).
Conclusion: In young healthy individuals, actigraphy-derived sleep characteristics were not related to central hemodynamics or non-invasive indices of arterial stiffness. Previously documented relationships between sleep and vascular function may be limited to less healthy populations, poorer sleepers, or only for certain sleep metrics.
Support (if any):

072

SLEEP SPINDLE HARMONICS IN INSOMNIA

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Introduction: Prior research has reported NREM spectral EEG differences between individuals with insomnia and good-sleeper controls, including elevated high-frequency EEG power (beta/gamma bands, ~16-50Hz) and, to a lesser extent, elevations in sleep spindle parameters. However, the mechanisms driving these differences remain unclear. Harmonics have been observed in EEG data as spectral peaks at multiples of a fundamental frequency associated with an event (e.g., for a 14Hz spindle, the 2nd harmonic is expected to be a peak at 28Hz).

Thus far, there has been very limited application of this idea of spectral harmonics to sleep spindles, even though these patterns can indeed be seen in some existing literature. We sought to build on this literature to apply spectral harmonic analysis to better understand differences between insomnia and good sleepers.

Methods: 15 individuals with insomnia disorder (DSM-5 criteria, 13 female, age 18–32 years) and 15 good-sleeper controls (matched for sex, age, and BMI) completed an overnight polysomnography recording in the laboratory and subsequent daytime testing. Insomnia diagnosis was determined by a board-certified sleep specialist, and exclusion criteria included psychiatric history within past 6 months, other sleep disorders, significant medical conditions, and medications with significant effects on inflammation, autonomic function, or other psychotropic effects.

Results: Consistent with prior studies, we found elevated sleep spindle density and fast sigma power (14-16Hz). Despite no difference in beta or gamma band power when averaged across NREM sleep, time-frequency analysis centered on the peaks of detected spindles revealed a phasic elevation in spectral power surrounding the 28Hz harmonic peak in the insomnia group, especially for spindles coupled with slow waves. We also observed an overall pattern of time-locked delay in the 28Hz harmonic peak, occurring approximately 40 msec after spindle peaks. Furthermore, we observed a 42Hz '3rd harmonic' peak, not yet predicted by the existing modeling work, which was also elevated for insomnia.

Conclusion: In conjunction with existing mathematical modeling work that has linked sleep spindle harmonic peaks with thalamic relay nuclei as the primary generators of this EEG signature, these findings may enable novel insights into specific thalamocortical mechanisms of insomnia and non-restorative sleep.

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073

WHOLE-BRAIN NETWORK ANALYSIS OF NEURAL OSCILLATIONS DURING LIGHT SLEEP

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Introduction: Sleep is a highly stereotyped phenomenon that is ubiquitous across species. Although behaviorally appearing as a homogeneous process, sleep has been recognized as cortically heterogenous and locally dynamic. PET/fMRI studies have provided key insights into regional activation and deactivation with sleep onset, but they lack the high temporal resolution and electrophysiology for understanding neural interactions. Using simultaneous electrocorticography (EEG) and magnetoencephalography (MEG) imaging, we systematically characterize whole-brain neural oscillations and identify frequency specific, cortically-based patterns associated with sleep onset.

Methods: In this study, 14 healthy subjects underwent simultaneous EEG and MEG imaging. Sleep states were determined by scalp EEG. Eight 15s artifact-free epochs, e.g. 120s sensor time series, were selected to represent each behavioral state: N1, N2 and wake. Atlas-based source reconstruction was performed using adaptive beamforming methods. Functional connectivity measures were computed using imaginary coherence and across regions of interests (ROIs, segmentation of 210 cortical regions with Brainnetome Atlas) in multiple frequency bands, including delta (1-4Hz), theta (4-8Hz), alpha (8-12Hz), sigma (12-15Hz), beta (15-30Hz), and gamma (30-50Hz). Directional phase transfer entropy (PTE) was also evaluated to determine the direction of information flow with transition to sleep.

Results: We show that the transition to sleep is encoded in a spatially and temporally specific dynamic pattern of whole-brain functional connectivity. With sleep onset, there is increased functional connectivity diffusely within the delta frequency, while spatially specific profiles in other frequency bands, e.g. increased fronto-temporal connectivity in the alpha frequency band and fronto-occipital connectivity in the theta band. In addition, rather than a decoupling of anterior-posterior regions with transition to sleep, there is a spectral shift to delta frequencies observed in the synchrony and information flow of neural activity.

Conclusion: Sleep onset is cortically heterogeneous, composed of spatially and temporally specific patterns of whole-brain functional connectivity, which may play an essential role in the transition to sleep.

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BASAL FOREBRAIN GABAERGIC NEURONS PROMOTE AROUSAL BY DISINHIBITING THE OREXIN NEURONS VIA LOCAL GABAERGIC INTERNEURONS

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Introduction: Optogenetic and chemogenetic studies have shown that activation of basal forebrain (BF) GABAergic neurons rapidly wakes up mice from non-REM (NREM) sleep. These wake-promoting responses have been attributed to BF GABAergic neurons projecting to the cerebral cortex and more specifically to the inhibition of cortical fast-spiking interneurons. Tracing studies have however found that BF GABAergic neurons also densely innervate the lateral hypothalamus (LH) perifornical area, although the role of this pathway in behavioral state control remains mostly unexplored.
Methods: We conducted in vivo and in vitro optogenetic studies. We selectively expressed channelrhodopsin-2 (ChR2) in BF GABAergic neurons by injecting a cre-dependent viral vector encoding for ChR2 into the BF of VGAT-cre mice. We photostimulated the BF GABAergic input to the LH with optical fibers placed into the LH of EEG instrumented mice. For in vitro recordings we expressed ChR2 in BF GABAergic neurons and we fluorescently labeled orexin or LH GABAergic neurons. We recorded in brain slices from identified orexin neurons or GABA neurons while photostimulating the BF GABAergic input.
Results: Optogenetic stimulation of the BF GABAergic fibers in the LH produced rapid arousals from NREM sleep. The same stimulation however did not wake up the mice if they were in REM sleep. We conducted additional studies in brain slices to identify the postsynaptic neurons in the LH targeted by the BF GABAergic input. We found that while optogenetic stimulation of the BF GABAergic input did not produce opto-evoked synaptic responses in the orexin neurons, it produced short-latency opto-evoked inhibitory postsynaptic currents (IPSCs) in LH GABAergic neurons. These opto-evoked IPSCs were GABAA receptor-mediated and were maintained in tetrodotoxin (TTX) indicating monosynaptic connectivity. We have previously found that orexin neurons are inhibited by local LH GABAergic neurons. Our hypothesis is that these local GABAergic interneurons are the target of the BF GABAergic arousal input.
Conclusion: BF GABAergic neurons drive arousal through projections to the LH. We propose that this arousal response is due to the inhibition of local GABAergic interneurons which in turn disinhibit the LH wake-promoting neurons including the orexin neurons.
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075

SYSTEMATIC INDIVIDUAL DIFFERENCES IN VULNERABILITY TO SLEEP INERTIA

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Introduction: Sleep inertia (SI), the transient grogginess and disorientation that occurs upon awakening, may be particularly problematic in on-call operations that require safety-sensitive and time-critical action, such as healthcare and emergency response. The magnitude of SI is determined by multiple factors, including sleep history, and anecdotal evidence suggests individuals may differ considerably in susceptibility to impairment from SI.
Methods: As part of a larger study investigating individual differences in neurobehavioral impairment, N=21 healthy adults (aged 21–38y; 9 females) completed three laboratory-based neurobehavioral testing sessions, each preceded by baseline sleep. Baseline sleep and nightly at-home sleep opportunities during the week prior were either 12h (extended) or 6h (restricted); two sessions involved extension and one involved restriction in randomized, counterbalanced order. Baseline sleep opportunities ended at 10:00, whereupon subjects completed a 60min neurobehavioral test battery, which began with the Karolinska Sleepiness Scale (KSS). The test battery was repeated every 2h throughout the testing sessions.
Results: A nonlinear mixed-effects regression, controlling for prior sleep restriction/extension and session number, was used to estimate the subjective magnitude of SI immediately upon awakening from baseline sleep, as measured by KSS scores, and the exponential dissipation rate of the effect relative to KSS scores later in the day (12:00-20:00). Following prior sleep extension, SI was associated with a 1.82±0.59 KSS score increase ($p=0.006$), which subsequently dissipated from a level of 4.80±0.65 to 2.98±0.29 ($p=<0.001$) later in the day. Following prior sleep restriction, SI was associated with a 1.58±0.58 KSS score increase ($p=0.014$), which subsequently dissipated from a level of 5.39±0.63 to 3.80±0.30 later in the day. SI took ~45min to dissipate to a negligible level based on a time constant estimate of 23.6±15.8min. Importantly, there were substantial, systematic individual differences in the magnitude of SI, with a between-subjects standard deviation of 1.15±0.42 points on the KSS (ICC=0.51, $F=19.5$, $p<0.001$).
Conclusion: We observed sizeable, systematic individual differences in subjective sleepiness due to sleep inertia. To what degree these individual differences predict objective performance deficits remains to be investigated.
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BRIGHT LIGHT DURING WAKEFULNESS IMPROVES OBJECTIVE AND SUBJECTIVE SLEEP QUALITY: A FORCED DESYNCHRONY STUDY

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Introduction: Under real life conditions, increased light exposure during wakefulness seems associated with improved sleep quality, quantified as reduced time awake during bed time, increased time spent in non-REM (NREM) sleep or increased power in the EEG delta band (0.5–4 Hz). The causality of these important relationships and their dependency on circadian clock phase and/or time awake has not been studied in depth. To establish causality of light effects during wake time on subsequent sleep, and to disentangle possible circadian and homeostatic interactions, we employed a forced desynchrony (FD) protocol under dim light (6.5 lux) and bright light (1307 lux) during wakefulness.

Methods: The protocol consisted of a fast cycling sleep-wake schedule (13h wakefulness – 5h sleep; 4 cycles), followed by 3h recovery sleep in a within subject cross-over design. Individuals (7 men) were equipped with 10 polysomnography electrodes. Subjective sleep quality was measured immediately after wakening.

Results: Results indicated that circadian variation in delta power was only detected under dim light. Circadian variation in time in rapid eye movement (REM) sleep and wakefulness were uninfluenced by light. Prior light exposure increased accumulation of delta power and time in NREM sleep, while decreasing wakefulness, especially during the circadian wake phase. Subjective sleep quality scores showed that participants were only able to assess light induced improvement of sleep quality correctly when the circadian system promoted wakefulness.

Conclusion: This study presents significant effects of bright light exposure on sleep architecture, leading to sleep pressure related changes in objective sleep quality. At the end of the scheduled sleep phase after increased light exposure, more delta power and NREM sleep were detected, especially when sleep occurred outside the normal sleep phase. Subjective sleep quality scores showed light-induced improvements coinciding with increased delta power and time spend in NREM sleep, suggesting that light during wakefulness may improve subsequent sleep quality. These findings may have important implications for insomnia treatment and clinical applications of light therapy.

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HUMAN ACTIVITY LEVELS REFLECT CIRCADIAN INFLUENCES INDEPENDENT OF SLEEP/WAKE BEHAVIOR

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Introduction: Actigraphy is a non-invasive method that allows long-term recordings of activity, light, and other variables in diverse environments. In real-world settings, activity usually has a 24-hour rhythm that may arise from sleep/wake-associated behavior and/or circadian rhythmicity. We tested for an independent circadian component using data from people living on non-24 hours "days" in the laboratory.

Methods: Data are from five inpatient studies with tightly-controlled forced desynchrony (FD) conditions. Participants (19–34 yo) were healthy by history, physical exam, laboratory tests of blood and urine, and clinical polysomnography, and did not report using prescription medicines. Caffeine-containing substances were prohibited during the study. Protocol 1: 7 participants (3 F) T-cycle (i.e., FD sleep-wake cycle duration) = 42.85h; Rest:Activity ratio 1:3.3. Protocol 2: 8 participants (3 F) T cycle =42.85h; Rest:Activity 1:2. Protocol 3: 9 participants (3 F) T cycle =28.0h; Rest:Activity 1:2. Protocol 4: 7 participants (3 F) T cycle =20.0h; Rest:Activity ratio 1:3.3. Protocol 5: 7 participants (5 F) T cycle =20.0h; Rest:Activity 1:2. At all times except during showers, participants wore an actiwatch that measured activity levels and light. Melatonin period and phase 0 (i.e., fit maximum) were computed using non-orthogonal spectral analyses. Data were analyzed relative to 3-hr Circadian Phase bins (1/8 of computed circadian period for each individual) and 3-hr Wake Duration bins. Activity data were summarized using Zero-Inflated-Poison-based statistics for each Circadian*Wake Duration bin for each individual and then across individuals within each study. Repeated measures ANOVA were conducted. Statistics were performed using SAS.

Results: For all protocols, there were significant differences (all $p<0.007$) by individual participant, by Circadian Phase, and by Wake Duration bin, but not by the interaction term (Circadian Phase* Wake Duration). Highest levels of activity were at Circadian Phase 7.5–10.5 (~10am–1pm) and lowest values at Circadian Phase -1.5–1.5 (~midnight–3 am). Activity values were lowest at scheduled sleep times.

Conclusion: Circadian rhythms independent of sleep/wake behaviors influence activity levels and may be an important component of analyses. In individuals living on non-24-hr days (e.g., some blind people and some sighted people with Non-24-hr Sleep Disorder), it may be possible to derive circadian-based metrics.

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078

CHRONIC SLEEP AND CIRCADIAN DISRUPTION DIFFERENTIALLY AFFECTS BLOOD PRESSURE, RENAL SODIUM RETENTION, AND ALDOSTERONE SECRETION

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Introduction: Chronic sleep restriction (CSR) and recurrent circadian disruption (RCD; e.g., rotating shiftwork) can increase an individual's risk of cardiovascular and kidney disease. However, no study has assessed whether CSR and RCD together increase blood pressure (BP) and alter renal function (RF). We tested the hypotheses that the combination of CSR and RCD would increase blood pressure, renal sodium retention, and aldosterone secretion in individuals living for 3 weeks on an imposed non-24-h sleep-wake (SW) schedule (induces RCD) and controlled diet with or without CSR.

Methods: Seventeen (9M) healthy participants (aged 26.1±4.5y [mean±SD]) were scheduled to twenty-four 20-h Forced Desynchrony days and were randomized to either Control (1:2 sleep:wake, 6.67h sleep:13.33h wake; n=8) or CSR (1:3.3 sleep:wake, 4.67h sleep: 5.33h wake; n=9) SW conditions during a 32-day inpatient protocol. BP was measured following ~80–90 min in constant seated posture after scheduled waketime. All urine voids were collected, combined

and sampled in 3-6h blocks throughout the study. Samples were assayed for sodium, potassium and aldosterone and analyzed as both excretion rates and total secretion (both per 20h). Data were assigned circadian phase using fitted core body temperature and analyzed using mixed-effects models with circadian phase, aligned/misaligned sleep, or time awake (with associated scheduled activity, sleep/wake, and feeding behaviors) and their interactions as fixed effects.

Results: There was a significant interaction between aligned/misaligned sleep and condition for resting BP ($p=0.02$), such that systolic BP was ~6% higher following circadian-misaligned sleep in CSR compared to Control ($p=0.04$). Renal sodium and potassium followed a robust circadian pattern ($p<0.0001$), with limited influence of time awake. In contrast, the timing of aldosterone excretion was affected by time awake ($p<0.05$). Total daily renal sodium secretion decreased from beginning to end of the protocol ($p=0.03$), with no change in sodium consumption and aldosterone secretion ($p=0.95$).

Conclusion: Under conditions similar to rotating shiftwork, systolic BP increased and sodium, potassium, and aldosterone were differentially influenced by circadian phase and scheduled behaviors. Additionally, renal sodium secretion decreased despite minimal changes in aldosterone secretion, suggesting increased renal aldosterone sensitivity. These findings may provide insight into mechanisms contributing to poor cardiovascular and renal health observed in shiftwork.

Support (if any):

079

SLEEP QUALITY PREDICTION DURING THE MENSTRUAL CYCLE BASED ON DAILY SLEEP DIARY REPORTS

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Introduction: Estrogen and progesterone cycle through two main phases across a typical 28-day menstrual cycle: a perimense phase, when both hormones are low; and a non-perimenses phase, when both hormones are high. These fluctuations affect a range of daily activities, including sleep, mood, and physical feelings such as bloating. Here we aimed to predict differences in sleep quality during the perimenses and non-perimenses phases based on their daily reports.

Methods: We analyzed over 1200 nights of sleep diaries collected from 20 (18–35 yo) women across two months. We categorized days into perimenses when a night fell within 4 days prior to and 6 days after their self-reported first day of menses, and non-perimenses when a night fell 4 days before and 4 days after their reported positive ovulation. A random forest model was utilized in three different cases: 1) including the data associated with perimenses days 2) non-perimenses days and 3) considering the full data.

Results: Using the full data set we predicted subjects' sleep quality with 70% accuracy. For the perimenses group our model predicted sleep quality with more than 80% accuracy while the prediction accuracy for non-perimenses was as high as 75%. Further, we observed that for perimenses women, overall alertness and alcohol consumption were among the most important features extracted from daily reports, while for the non-perimenses group, subjective happiness ratings and physical feelings of bloating were predicting sleep quality. Together our result showed that sleep quality reported on a daily basis can be predicted more accurately based on the phase of the menstrual cycle, where different daily features may play differential roles.

Conclusion: Sex hormones' fluctuations across a month of menstrual cycle can affect a range of women's daily functioning. We showed that the phase in menstrual cycle can influence women's daily reports of their routines. Furthermore the fluctuations in these reports can be used to predict females' sleep quality with higher accuracy compared to when the phase of menstrual cycle is not accounted for. Our results show the importance of considering the role of menstrual cycle when investigating sleep quality.

Support (if any):

080

IS NAPPING ONLY BENEFICIAL TO EVENING CHRONOTYPES? A PILOT STUDY

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Introduction: Research shows associations between chronotype and behavior. While eveningness is associated with lower levels of self-control, morningness is associated with increased conscientiousness. Additionally, throughout the day, the increase in homeostatic sleep pressure due to wakefulness can affect executive functioning, including emotional regulation. Napping is an effective countermeasure to sleepiness and associated emotional dysregulation, but the impact of chronotype on this benefit is unknown. Therefore, this study aimed to examine the impact of chronotype and a midday nap on an aspect of emotional regulation: frustration tolerance.

Methods: 40 participants between the ages of 18–50 were randomized into a 60-minute, midday nap or no-nap condition. Chronotype was measured using the Horne-Östberg Morningness-Eveningness Questionnaire (MEQ). Frustration tolerance (FT) was measured pre and post nap using an adaption of Feather's frustration tolerance task where FT was measured as the time spent on an impossible task. To examine the association of chronotype and FT, correlational analysis was used. Chronotype was also determined using a median split of the MEQ due to few true morning and evening types in the sample. This data was then subjected to a repeated measures ANOVA with condition (pre or post-nap) as a within-subjects factor and group (nap or no-nap; high or low MEQ score) as between-subject factors.

Results: Results revealed a significant correlation between MEQ score and change in time spent on the impossible task, with those with lower MEQ scores (more evening) showing an increase in time spent on the impossible task, $r(20) = -.51$, $p = .016$. Similarly, results of the ANOVA revealed a significant condition (pre or post-nap) by group (nap, no nap; high, low MEQ) interaction, $F(1,1) = 4.694$, $p = .039$, such that, those in the nap group with lower MEQ (more evening) spent more time on the impossible task following the nap.

Conclusion: Our results indicate that chronotype may impact a nap's positive effect on emotional regulation, with greater benefit for those with the eveningness chronotype. Because napping is currently practiced by 1/3 of American adults, from a personalized medicine perspective, it's imperative that its chronotype-dependent benefits be investigated further to effectively guide evidence-based recommendations.

Support (if any):

081

IMPLICIT AND EXPLICIT STIGMA TOWARDS EVENING TYPES

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Introduction: Negative explicit and implicit stigma surrounding mental and physical health conditions are endorsed by people with and without these conditions. Stigma can lead to adverse consequences such as higher levels of distress and isolation. People with insomnia report internalized stigma associated with their insomnia and often delay treatment as a result. Although anecdotal reports of a similar stigma exist for delayed chronotypes, particularly among emerging adults, this effect has not been empirically examined. The present study aims to examine explicit and implicit attitudes about chronotype in a sample of emerging adults.

Methods: Participants were undergraduates (M age=19.9 [SD=1.5], 83.7% female). Demographic, sleep, and circadian questionnaires, including the Morningness-Eveningness Questionnaire to assess chronotype, were collected. Explicit stigma was measured by rating morning and evening types from 0–100 on eight pairs of opposing characteristics (e.g., lazy/motivated) and means were compared with paired samples t-tests using correction for multiple comparisons. Implicit stigma was measured using the Implicit Association Test with attributes associated with "good" and "bad" and targets of "night owl" or "early bird" and the mean score was compared to benchmarks. Regression was conducted to determine whether chronotype predicted implicit or explicit attitudes.

Results: Analyses of explicit attitudes revealed evening types were rated as possessing significantly more of the following characteristics: Lazy (Cohen's d=0.71), Unhealthy (1.22), Undisciplined (1.19), Immature (0.64), Creative (0.59), and Young (1.20), adjusted ps<.01. Analysis of implicit attitudes revealed a d score of 0.57 (SD=0.47), which indicates a moderate implicit bias of pairing "night owl" with "bad" and "early bird" with "good." Chronotype was not significantly associated with implicit or explicit attitudes, $F(1,47)=0.04$, $p=.849$.

Conclusion: Overall, greater negative explicit and implicit stigma were found for eveningness tendency compared to morningness tendency. Creativity and youthfulness were also rated higher for eveningness. Individual chronotype did not predict implicit or explicit attitudes, suggesting a potential broad societal bias rather than a specific internalized bias. As explicit and implicit stigma often predict discriminatory behavior and lead to negative consequences for the target group, future studies should examine how negative stigma may impact evening types and the behavioral and psychological consequences of stigma.

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082

THE ASSOCIATION BETWEEN EXCESSIVE DAYTIME SLEEPINESS AND MATH PERFORMANCE IN ADOLESCENTS

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Introduction: Excessive daytime sleepiness (EDS) is defined as an increased tendency to fall asleep in a setting where an individual would be expected to stay awake and alert. Previous studies have found that EDS is associated with poor academic performance but fell short of examining the associations between EDS and achievement in specific academic subjects. Academic performance in mathematics is the most prominent predictor of later success. Findings from studies examining the associations of academic achievement in math and EDS have been inconsistent as some studies have found results indicating the EDS negatively impacts math while others found no such relationship. The aim of this study was to investigate the association between EDS and performance in mathematics in high school students. It was hypothesized that higher level of reported EDS would be associated with lower grades in mathematics.

Methods: 116 typically developing adolescents (38 male) between 12–17 years of age (M=13.87, SD=1.38) participated. EDS was measured by the Sleep Disorder Inventory for Students (SDIS); Academic achievement in mathematics was measured by child's report cards; Sleep was assessed for seven nights using actigraphy and sleep logs.

Results: A hierarchical multiple regression analysis was conducted to examine the associations between parent-reported EDS (independent variable) and their child's academic achievement in mathematics (dependent variable) while controlling for sleep variables (bedtime, waketime, and duration) and sex. Higher levels of EDS was negatively associated with lower grades in mathematics [$F(5,109)= 3.60$, $p<.01$; $\beta= -0.21$, $p= 0.03$].

Conclusion: EDS was significantly associated with report card grades in mathematics in typically developing adolescents. Given the cross-sectional design of the study, it can not identify what led to EDS in this sample of typically developing adolescents. We propose that future studies examine potential causes for adolescents' EDS, including factors that could impair sleep quality (e.g., undiagnosed sleep disorders) or restrict sleep duration (e.g., life-style choices such as the use of electronic devices at night). This is important as it could help to identify targets for intervention aiming at decreasing EDS and ultimately improving academic performance in mathematics.

Support (if any):

083

CIRCADIAN PREFERENCE IS ASSOCIATED WITH IMPULSIVITY AT BOTH THE TRAIT AND STATE LEVEL

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Introduction: Impulsivity is a multifaceted construct with well-documented risk for substance use problems. A circadian preference towards eveningness has been linked to trait, global impulsivity. Here we extend existing literature by investigating whether eveningness is associated with multiple facets of impulsivity at both trait- and state-level impulsivity. We also examined these associations utilizing daily measures of sleep timing and duration.

Methods: The primary sample included 78 moderate-to-heavy social drinkers (aged 21–35, 100% White men) with circadian preference data (Composite Scale of Morningness: CSM). Five facets of impulsivity were assessed via the UPPS-P, both at baseline (full scale) and up to 6 times per day over 10 days (reduced scale). Daily sleep timing (midsleep) and duration were assessed via self-report over 10 days. Multilevel models were used to examine between- and within-person associations, accounting for covariates and correcting for multiple comparisons.

Results: Between-person models found that eveningness was associated with multiple facets of impulsivity, at trait (lack of perseverance) and state levels (negative urgency, positive urgency, lack of perseverance, and lack of premeditation). However, average midsleep and duration were generally unrelated to impulsivity when accounting for circadian preference. Within-person models in the primary sample largely paralleled the between-person findings. In a larger, more diverse sample (29.1% self-identified as Black, 29.7% female) without CSM data, later midsleep timing was associated with greater mean state-level impulsivity across multiple facets. These effects largely appear to be driven by White women.

Conclusion: A circadian preference for eveningness is strongly associated with multiple facets of impulsivity, at both trait- and state-levels, potentially increasing risk for substance use. This association does not appear to be driven by actual daily sleep timing and/or duration. Future research with objective measures of sleep in larger, more diverse samples will be important to clarify implications for sleep-focused prevention and/or treatment of substance use.

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DOES ALIGNMENT BETWEEN THE TIMING OF SLEEP AND CIRCADIAN RHYTHM PREDICT BEHAVIORAL DECISION MAKING?

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Introduction: Cognitive performance and decision making have been shown to suffer under conditions of misalignment between circadian preference and time-of-assessment; however, little is known about how misalignment between the timing of sleep and circadian rhythm impacts decision making. To this end, this study captured naturally occurring degrees of alignment between the timing of sleep and the circadian rhythm (i.e., alignment of sleep-wake timing with circadian phase) to examine if greater misalignment predicts worse behavioral decision making.

Methods: Over the course of two weeks, 32 participants (18–22 years of age; 61% female; 69% White) continuously wore actigraphs and completed two overnight in-lab visits (Thursday and Sunday) in which both dim light melatonin onset (DLMO) and behavioral decision-making (risk taking, framing, and strategic reasoning tasks) were assessed. Sleep-wake timing was assessed by actigraphic midsleep from the two nights prior to each in-lab visit. Alignment was operationalized as the interval between DLMO and average midsleep. Multilevel modeling was used to predict performance on decision making tasks from circadian alignment during each in-lab visit; nonlinear associations were also examined.

Results: Misalignment characterized by shorter time between DLMO and midsleep predicted decision-making in a curvilinear fashion (i.e., squared misalignment term predicted performance). Specifically, shorter time between DLMO and midsleep predicted greater risk-taking under conditions of potential loss ($B = .10$, $p = .04$), but less

risk-taking under conditions of potential reward (B = -.14, p = .04) in a curvilinear fashion. Misalignment did not predict decision-making in the framing and strategic reasoning tasks.
Conclusion: Findings suggest that naturally occurring degrees of misalignment between the timing of sleep and the circadian rhythm may impact risky decision-making, further extending accumulating evidence that sleep/circadian factors are tied to risk-taking preferences. Future studies will need to replicate findings and experimentally probe whether manipulating alignment influences risky decision making.
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085

EFFORT EXERTION AND GOOD SLEEP INTERACTIVELY INCREASE THE SUBJECTIVE VALUE OF THE FUTURE

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Introduction: The present study examined how habitual variation in sleep quality shapes reward responsivity following effort exertion. Behavioural and neuroscientific theory and research suggest that expending effort leads to compensatory increases in reward responsivity. Converging evidence links the preference for larger-but-delayed rewards to increases in reward sensitivity in psychophysiological, psychopharmacological, and animal studies. Accordingly, we hypothesized that exerting mental effort would increase the preference for larger-but-delayed rewards (i.e., the subjective value of the future) insofar as these preferences reflect elevated reward responsivity. Furthermore, given that sleep shapes perceptions of effort and preferences for larger-but-delayed rewards, we hypothesized that this finding would be moderated by habitual variation in sleep quality, with the strongest effects apparent among participants reporting habitually good sleep.
Methods: To test these hypotheses, we recruited 79 participants to complete a 10-minute effortful (vs. control) writing task followed by a delay discounting task and the Pittsburgh Sleep Quality Index.
Results: As hypothesized, the effortful writing task (vs. control) participants demonstrated a greater preference for larger-but-delayed rewards (vs. smaller-but-immediate rewards). This effect was moderated by sleep quality with those high but not low in sleep quality showing the hypothesized effect.
Conclusion: Ultimately, we found that exerting mental effort increases the subjective value of the future, particularly among participants who habitually report good sleep. These results suggest that good sleep quality helps us contend with the effortful demands of daily life in a way that promotes long-term goal pursuit.
Support (if any):

086

SLEEP MIDPOINT AFTER JOB LOSS PREDICTS BREAKFAST SKIPPING PATTERNS

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Introduction: Few studies have examined circadian phase after job loss, an event that upends daily routine. It is common that a daily routine begins with the consumption of breakfast, and breakfast behavior may contribute to health status in adults. Therefore, we sought to examine whether a later midpoint of sleep was associated with breakfast skipping among adults whose schedules were no longer dictated by employment.
Methods: Data were obtained from the Assessing Daily Activity Patterns Through Occupational Transitions (ADAPT) study. The sample of 155 participants had involuntarily lost their jobs in the last 90 days. Both cross-sectional and 18-month longitudinal analyses assessed the relationship between sleep midpoint after job loss and current and later breakfast skipping. Assessment periods were 14 days. Sleep was measured via actigraphy, and breakfast skipping was measured via daily diary (1 = had breakfast; 0 = did not have breakfast). The midpoint of sleep was calculated as the circular center based on actigraphy sleep onset and offset times.
Results: The midpoint of sleep at baseline was negatively associated with breakfast consumption at baseline (B = -.09, SE = .02, p = .000). Also, a later midpoint was associated with breakfast skipping over the next 18 months (estimate = -.08; SE = .02; p = .000). Prospective findings remained significant when adjusting for gender, ethnicity, age, perceived stress, body mass index (BMI), education, and reemployment over time. Education (estimate = 14.26, SE = 6.23, p < .05) and BMI (estimate = -.51, SE = .25, p < .05) were the only significant covariates. No other sleep indices predicted breakfast behavior cross-sectionally or prospectively.
Conclusion: Consistent with research in adolescents, unemployed adults with a later circadian phase are more likely to skip breakfast more often. Breakfast skipping was also associated with higher BMI. Taken together, these findings provide support for the future testing of sleep/wake scheduling interventions to modify breakfast skipping and potentially mitigate weight gain after job loss.
Support (if any): #1R01HL117995-01A1

087

GENDER DIFFERENCES IN ATTITUDES TOWARDS SLEEP MODERATE SLEEP HYGIENE BEHAVIORS

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Introduction: Attitudes towards sleep have been shown to be a predictor for sleep hygiene. Sleep hygiene is the set of behaviors and conditions that promote optimal sleep, such as avoiding arousing nighttime activities, avoiding eating too close before bed, having a dark and quiet bedroom, and having a regular sleep schedule. Previous literature indicates that there are gender differences in health attitudes. This study examined whether gender differences in sleep attitudes may explain differences in sleep hygiene.
Methods: A sample of 172 (101 males, 71 females) individuals completed surveys through Amazon's Mechanical Turk. Sleep attitudes were assessed using the Charlotte Attitudes Towards Sleep Scale (CATS; Peach & Gaultney, 2017). Sleep hygiene was measured using the Sleep Hygiene Practice Scale (SHPS; Lin et al; 2007; Yang et al., 2010). Males were dummy coded as 0. Other data were collected surrounding sleep outcomes, health behaviors, and demographics. Linear regression analyses were ran to examine the impact of Sleep attitudes, gender, and an interaction term on each subscale of the SHPS.
Results: Sleep attitudes significantly predicted each of the components of the SHPS: arousal, eating, environment, and time (b = -3.44, -2.93, -3.80, -3.04; p<.01 for each). Gender significantly predicted sleep hygiene behaviors for eating (b = -10.35, p<.05) and environment (b = -15.40, p<.05) only. The interaction term also significantly predicted sleep hygiene eating behaviors (b = 1.70 p<.05) and environmental conditions (b = 2.91, p<.05). These findings suggest that more favorable sleep attitudes lead to better sleep hygiene behaviors, and

women tend to have better eating and environment related sleep hygiene behaviors. Graphs of the interactions indicated males' sleep attitudes associated with greater differences in sleep hygiene practices, in that positive sleep attitudes predicted better eating and environment elements of sleep hygiene.
Conclusion: This exploratory research suggested that men's sleep-related behaviors may be more sensitive to the role of sleep attitudes. Future research should explore causes for gender differences in sleep attitudes and seek ways to improve behaviors and outcomes that are most relevant for specific demographic groups.
Support (if any): Psychological Sciences department funding

088

IRREGULAR SLEEP PATTERNS PREDICT WORSE SLEEP QUALITY AND POORER PSYCHOSOCIAL AND ACADEMIC OUTCOMES

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Introduction: While the consequences of short sleep duration are well understood, relatively little is known about how irregular sleep durations are related to daily functioning. We utilized actigraphy and self-report methods to investigate the correlates of intraindividual sleep variability in two populations.
Methods: In Study 1, N=699 adults (mean age=38.04, SD=11.65; 44.78% female) completed online questionnaires on sleep, work status, and time management. In Study 2, N=100 college students (mean age=19.08, SD=1.26; 50% female; 50% underrepresented minorities) wore actiwatches for two one-week sessions (1 month apart) and reported sleep, psychosocial functions, and academic outcomes. In both studies, variability of sleep duration was defined as the individual standard deviation (ISD) of sleep durations.
Results: In Study 1, after controlling for mean sleep duration, greater variability in sleep duration was related to shiftwork ($F=8.68$, $p=.003$), younger age ($r=-.15$, $p<.001$), male gender ($F=4.43$, $p=.036$), and greater vulnerability to stress ($r=.15$, $p=.001$). Beyond mean sleep duration, variability in sleep duration also predicted poorer sleep quality ($r=.25$, $p<.001$), greater sleepiness during the day ($r=.10$, $p=.014$), poorer time management ($r=-.09$, $p=.031$), lower work efficiency ($r=-.14$, $p=.002$), and more procrastination ($r=.11$, $p=.009$). In Study 2, variability in actigraphy-defined sleep duration increased as the semester progressed (ISD=1.25±0.55 hours at T1; ISD=1.57±0.80 hours at T2, $t=4.64$, $p<.001$). After controlling for mean sleep duration, sleep variability was associated with greater perceived stress ($r=.31$, $p=.002$ at T1), poorer sleep quality ($r=.39$, $p<.001$ at T1; $r=.30$, $p=.003$ at T2), and lower expected grades ($r=-.27$, $p=.01$ at T2). Sleep variability was unrelated to depression or perceptions of one's overall health.
Conclusion: Keeping regular sleep habits appear just as important as average sleep duration to psychosocial, work, and academic outcomes. Sleep interventions should incorporate specific guidelines on how to promote regular sleep and employers should institute work schedules that promote regularity.
Support (if any): This work is supported by the National Science Foundation, Psi Chi Honor Society, and the American Psychological Association.

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IMPACT OF A SINGLE SLEEP EDUCATION SESSION ON BELIEFS AND ATTITUDES AMONG PEOPLE WITH EXCESSIVE DAYTIME SLEEPINESS: A PILOT STUDY

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Introduction: Excessive daytime sleepiness is associated with adverse health outcomes and substantial functional deficits. However, little is known about experiences among these individuals and whether some education about sleep health would be helpful.
Methods: N=28 participants with excessive daytime sleepiness (ESS>=10) but no other major medical problems were recruited from the community. The intervention was a single 2-hour sleep education workshop. Participants were randomized to either the education session or a wait-list control. Change from baseline on Epworth Sleepiness Scale (ESS), Dysfunctional Beliefs About Sleep (DBAS) scale, Fatigue Severity Scale (FSS), Insomnia Severity Index (ISI),pHQ9 depression scale, and GAD7 anxiety scale were evaluated versus controls, adjusted for age, sex, and race/ethnicity. Also,participants were asked whether they agree to a range of beliefs/attitudes about sleep before and after the session (as part of intervention or following wait list). Posttest-Pretest difference scores were compared to determine if any were changed by the session (nominal significance $p<0.05$).
Results: Compared to the wait-list control, those who received the education session did not show differences in sleepiness (4.2% reduction,$p=0.73$) or dysfunctional beliefs about sleep (52.1% reduction,$p=0.07$), but they did demonstrate a 26.5% reduction in fatigue ($p=0.01$), a 55.2% reduction in insomnia severity ($p=0.004$), a 59.1% reduction in depression score ($p=0.02$), and a 54.5% reduction in anxiety score ($p=0.04$). The single session resulted in increased agreement with the statements, "People with daytime sleepiness should discuss their problems with their doctor or health care provider" ($t=-2.3$,$p=0.03$), "I understand the basics of how sleep works" ($t=-2.2$,$p=0.04$), "I understand the basics of how sleepiness works" ($t=-2.7$,$p=0.01$), "Excessive daytime sleepiness is something that can be improved with psychological treatment" ($t=-2.3$,$p=0.03$), and "I know what to do if…" "I have trouble falling asleep" ($t=-4.3$,$p=0.0003$), "I have trouble with poor quality sleep" ($t=-5.1$,$p=0.0001$), and "I experience daytime sleepiness" ($t=-3.0$,$p=0.007$).
Conclusion: A brief sleep health education session improved sleep and mental health in individuals with daytime sleepiness, even if it did not improve sleepiness. Further, the session did likely provide useful educational information.
Support (if any): This work was supported by Jazz Pharmaceuticals

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STRATEGIES FOR DEALING WITH OR AMELIORATING EXCESSIVE SLEEPINESS: BELIEFS AND ATTITUDES OF PEOPLE WITH DAYTIME SLEEPINESS

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Introduction: Sleepiness impacts health and functioning, but despite available treatments, many do not seek care. Beliefs and attitudes about treatments for sleepiness and other sleep problems may be useful to know in designing and targeting interventions.
Methods: N=28 participants with excessive daytime sleepiness (ESS>=10) but no other major medical problems were recruited from the community. They were administered an Epworth Sleepiness Scale and Fatigue Severity Scale at baseline, and asked about a wide range of beliefs/attitudes about mitigating sleepiness, and whether they Strongly Agree(SA), Agree(A), Disagree(D), or Strongly Disagree(SD) with them. Ordinal logistic regressions examined agreement associated with baseline sleepiness and fatigue, adjusted for age, sex, and race/ethnicity (nominal significance $p<0.05$).
Results: When asked which strategies are helpful for dealing with or fixing daytime sleepiness, baseline agreement was as follows:

Just "power through it" (SA:9%,A:55%,D:32%,SD:5%). Caffeine (SA:18%,A:55%,D:27%). Vigorous exercise (SA:9%,A:36%,D:55%). Mild or moderate movement or exercise (SA:14%,A:82%,D:5%). Trying to get better sleep at night (SA:36%,A:64%). Eating or drinking something to help "wake you up" (SA:27%,A:45%,D:23%,SD:5%). Napping (SA:27%,A:64%,D:9%). Giving up and letting yourself be sleepy (SA:9%,A:42%,D:45%,SD:5%). Improve your diet/eat healthy (SA:42%,A:55%,D:5%). Relaxing activities at night (SA:27%,A:68%,D:5%). Meditation, breathing exercises, or other relaxation techniques (SA:45%,A:45%,D:9%). Watching TV, browsing the internet, or other distracting activities (SA:5%,A:36%,D:45%,SD:14%). Just keep moving (SA:9%,A:55%,D:42%,SD:5%). Setting alarms (SA:18%,A:68%,D:14%). Take prescription medication to improve sleep (SA:5%,A:27%,D:42%,SD:27%). Take over-the-counter medication to improve sleep (SA:5%,A:27%,D:59%,SD:9%). Take prescription stimulant medication (SA:5%,A:32%,D:45%,SD:18). Take over-the-counter stimulant medication (SA:5%,A:27%,D:55%,SD:14%). Take prescription medication that reduces daytime sleepiness (SA:5%,A:36%,D:41%,SD:18%). Take over-the-counter medication that reduces daytime sleepiness (SA:5%,A:27%,D:50%,SD:18%). Those with higher levels of baseline sleepiness were more likely to endorse the following as good strategies to handle daytime sleepiness, "Take over-the-counter medication to improve sleep" (oOR=1.55, p=0.04), "Take prescription medication to improve sleep" (oOR=1.49, p=0.01), and "napping" (oOR=2.55, p=0.03). Those with higher baseline fatigue were less likely to endorse "just 'powering_through'" (oOR=0.81, p=0.02) as a good strategy of handling daytime sleepiness.
Conclusion: Real-world beliefs and attitudes about ways of mitigating effects of sleepiness range from medical to behavioral. Those with greater baseline sleepiness may be more amenable to medication.
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THE FEASIBILITY OF AT-HOME SLEEP EXTENSION IN ADOLESCENTS AND YOUNG ADULTS: A META-ANALYSIS AND SYSTEMATIC REVIEW

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Introduction: Insufficient sleep duration has negative consequences for health and performance and is alarmingly common in adolescents and young adults. The primary aim of the meta-analysis and systematic review was to assess whether at-home sleep extension is a feasible means to improve sleep duration and daytime sleepiness without negative consequences for sleep quality or efficiency in adolescents and young adults. An additional aim of the review was to provide a qualitative summary of the health and performance outcomes associated with at-home sleep extension.
Methods: Peer-reviewed journal articles and doctoral dissertations available in English were searched and screened. Eligible studies had at least five consecutive days of at-home sleep extension, measurement of sleep duration during baseline/habitual sleep and extension of sleep opportunity, and participants 13–30 years of age. Information on primary sleep outcome (i.e., sleep duration), available secondary sleep outcomes (i.e., sleep opportunity, sleep efficiency, sleep quality, daytime sleepiness), and health and performance outcomes were extracted for quantitative synthesis and qualitative review.
Results: Of the 2254 articles assessed for eligibility, 17 studies (seven in adolescents and ten in young adults) met the eligibility criteria for this review. The average number of days of sleep manipulation was 14.29 (range: 5 to 49 nights). At-home extension of sleep opportunity reliably increased objective (ES = 0.97) and subjective sleep duration (ES = 2.19) and sleep quality (ES = 0.24), and decreased daytime sleepiness (ES = -0.39), when compared to unmanipulated sleep opportunity. Sleep extension was also found to have additional health (e.g., lower psychological stress) and performance benefits (e.g., better athletic performance) across ages and populations. A potential upward publication bias was found based on the distribution of within-subject effect sizes of actigraphic sleep duration.
Conclusion: The review indicates that at-home sleep extension is feasible in adolescents and young adults to improve sleep duration and daytime sleepiness, and maintain or improve sleep quality. However, the degree of improvement in sleep duration, sleep quality, and daytime sleepiness varied by study population and sleep extension method. Future research should investigate how variations in population and methods of sleep extension impact health and performance outcomes.
Support (if any):

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EFFECT OF THE DUAL OREXIN RECEPTOR ANTAGONIST (DORA) DARIDOREXANT ON BEHAVIOUR UPON AWAKENING IN RATS AND DOGS

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Introduction: The ability to be fast alert and to interact with the environment without motor impairment upon waking up, is a critical feature of natural sleep. DORAs represent a new class of insomnia medications that specifically inhibit the wake-promoting effects of orexin neuropeptides. Daridorexant is a potent and selective DORA under late stage development for the treatment of insomnia. Here, we assessed the impact of sleep-promoting doses of daridorexant on rats' and dogs' behaviour upon forced awakening. Zolpidem (a positive GABAA receptor modulator) was used as active comparator in rats because of its known negative impact on motor functions.
Methods: Rats were woken up at different time points after oral administration of daridorexant (10, 30, 100 mg/kg) or zolpidem (30, 100 mg/kg) during their inactive phase, and repeatedly subjected to two motor tasks: 1) the rotating rod test (lasting 120 sec, at each time point) assessing gross motor skills and coordination, and 2) the forepaw grip strength test assessing fine motor skills and muscle strength. Dogs were presented with food as an external, salient stimulus, three hours after administration of daridorexant in gelatin capsules (10, 30 or 90 mg/dog) during their active phase. Behaviour and signs of muscle weakness, after having woken up, were assessed by manual inspection of video recordings and concomitant electroencephalogram/electromyogram recordings.
Results: In both the rotarod and grip tests, daridorexant treatment had no effect on motor behavior at any dose or time point tested, while zolpidem significantly reduced the time spent on the rotarod and the grip strength in a dose and time-dependent manner (N=12/group; $p<0.001$;) (e.g. at 30 min post-dose, time spent on the rotarod was 84, 79–89 and 10–19 sec for vehicle, daridorexant and zolpidem, respectively). Dogs treated with daridorexant were able to wake up easily upon food presentation. They behaved and ate normally and did not show any signs of muscle weakness.
Conclusion: The type of sleep promoted by daridorexant is surmountable in rats and dogs and similar to physiological sleep. It allows animals to easily wake up, to behave normally without motor impairment and to respond efficiently to the environmental conditions.
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SLEEP AND MOOD ACROSS THE MENSTRUAL CYCLE IN YOUNG WOMEN

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Introduction: Sleep modulates mood, with adequate, good-quality sleep associated with a more positive mood. Additionally, sleep is affected by the menstrual cycle in women, with better self-reported sleep quality during non-menses, compared with pre- and during menses. The present study examines the interaction between self-reported sleep quality and mood across the menses (pre/during menses) and non-menses portion of the menstrual cycle.
Methods: 10 female participants (27± 2.96) completed sleep and mood diaries over a two month period, answering questions about their nighttime sleep quality and daily mood, and also marking days of menstruation. Each morning participants indicated on a 7-point scale how their overall sleep quality was the previous night. Then, each evening, participants indicated on a 7-point scale the extent to which they felt specific positive and negative moods throughout the day. Time lag cross-correlation and linear regression models were used to determine directionality of sleep quality and mood, and interaction between sleep quality, menses status, and mood levels.
Results: Better sleep quality was associated with better mood, with prior sleep quality predicting mood, but prior mood did not predict sleep (cross-correlation time lag = 0) across menses and non-menses. Additionally, on average women reported higher levels of sleep quality and better mood during the non-menses portion of their cycle. During the non-menses portion, women reported higher levels of positive mood (happy, pleased, and joyful), which were mediated by level of sleep quality. Women also reported lower levels of negative mood (depression, frustration, anxiety, unhappiness, and overwhelmed feelings), which were similarly mediated by level of sleep quality.
Conclusion: These findings are consistent with the hypothesis that sleep modulates mood, which fluctuates over the course of a woman's menstrual cycle. Moreover, our data suggest that perceived sleep quality impacts mood, and that the menstrual cycle affects both sleep quality and mood
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BEDTIME HUNGER PREDICTS REDUCED SLEEP EFFICIENCY THAT NIGHT IN USERS OF A CONSUMER SLEEP MEASUREMENT DEVICE

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Introduction: It has long been suspected that bedtime hunger can potentially disturb sleep. The neural circuits that control sleep are now known to receive signals of appetite and energy balance via hypocretin/orexin neurons from the lateral hypothalamus. But there remains need to specifically identify how, and under what conditions, appetite mechanisms affect human sleep. This study documents the relationship between bedtime hunger and subsequent sleep efficiency in users of a consumer sleep measurement device.
Methods: The Zeo headband (sold to the public during 2009–2013) used detected electrical potentials to periodically calculate the most probable stage of sleep or wake. Users uploaded sleep records online and could track nightly conditions — including bedtime hunger — on provided rating scales. De-identified summary data from these nightly records were aggregated into a research registry. We extracted the sleep records with bedtime hunger ratings and analyzed them using multilevel modeling to identify within-person and between-person relationships between bedtime hunger and sleep efficiency. We decomposed bedtime hunger ratings into person-mean hunger and nightly hunger, the difference between each night's hunger rating and the person's mean.
Results: 4,284 nightly sleep records with a bedtime hunger rating were provided by 183 people (age 19–77, 68% male, mean: 23 records/person). Sleep efficiency was not related to person-mean hunger ($p=0.26$), but was inversely related to nightly hunger that night ($p=0.01$). The model predicted a within-person difference in sleep efficiency between nights with high, versus low, nightly hunger that varied across the people in the sample (mean [range]: -2.4 [-12.5-1.6] percentage points) and correlated positively with typical sleep efficiency ($r=0.73$, $p=0.00$) and negatively with unexplained variability in sleep efficiency ($r=-0.47$, $p=0.00$).
Conclusion: For the people in this dataset, on average, going to bed hungrier than usual predicted reduced sleep efficiency that night. The effect was strongest in people who tend toward low and variable sleep efficiency. This finding strongly suggests that bedtime hunger can indeed disturb sleep, especially in poor sleepers. Further research is needed to determine who is most affected and to understand implications, such as for weight management, eating disorders, food insecurity, or sleep-supporting foods and dietary practices.
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STEERING WHEEL ANGLE EXCURSIONS AS A MEASURE OF FATIGUE-RELATED DRIVER PERFORMANCE IMPAIRMENT

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Introduction: Fatigue from sleep loss and circadian misalignment causes automobile driving performance impairment. Metrics based on steering wheel angle, which is straightforward to measure, could be used to quantify this impairment. As the tail of the distribution of steering wheel angles (absolute magnitude of deviation from center) increases with fatigue, we investigated whether driving performance impairment could be quantified based on the prevalence of steering wheel excursions beyond a given angle threshold. We used data from two published laboratory studies of simulated shift work, in which fatigue remained low during day shifts but increased across time awake during night shifts.
Methods: N=37 healthy adults (ages 26.8±5.2y; 25 men) were assigned to a simulated night shift schedule (awake 20:00-10:00) or day shift schedule (awake 08:00-22:00; study 1 only). After an adaptation period, participants underwent two 5-day shift cycles with an intervening rest period. Driving performance was measured on a high-fidelity simulator during adaptation (data not used) and four times at 3h intervals during each shift day. Every drive involved 30min driving at 55mph, including ten 0.5mi uneventful straightaways being considered here. Steering wheel angle was measured at 72Hz (study 1) or 60Hz (study 2). A total of 1,471 drives (31,394,498 angle measurements) were available for analysis.
Results: We investigated angle thresholds across 0.01-0.25rad in 0.01rad intervals and counted the corresponding number of threshold excursions in each drive for each participant. For study 1, we applied mixed-effects ANOVA with fixed effects for condition and time

awake, and their interaction, and determined the local effect size for interaction. A 0.03rad (1.7°) threshold yielded the greatest effect size, f^2=0.031 (small). For this threshold, we repeated the analysis using the data from both studies, controlling for study. The interaction was significant ($F[3,1428]=13.23$, $p<0.001$), showing low driving impairment across time awake during day shifts but increasing impairment across time awake during night shifts.

Conclusion: The prevalence of steering wheel excursions beyond a 1.7° angle threshold yielded sensitivity to fatigue-related driving performance impairment during simulated night shifts. Further research will extend our results to driving through curves and with greater fatigue levels.

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THE ASSOCIATION BETWEEN SLEEP REGULARITY INDEX AND SELF-REPORTED BEHAVIORAL AND EMOTIONAL SYMPTOMS IN ADOLESCENTS

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Introduction: Among adolescents, sleep health has been associated with emotional and mood regulation, cognitive functioning, and behavior. Few studies, however, have examined the Sleep Regularity Index (SRI, Phillips et. al, 2017) and its associations with mental health and well-being in this age group. For this study, we examined whether SRI in 15-16-year-old adolescents would predict internalizing and externalizing symptoms as measured by Youth Self-Report (YSR) scores two years later. We hypothesized that a higher baseline sleep regularity would predict lower internalizing and externalizing YSR scores at the 2-year follow-up.

Methods: The sample included 32 adolescents (14 male) ages 15-16yr (mean = 15.6) at baseline and 2 years later (mean age = 17.7). Actigraphy data and YSR scores were collected at baseline, and YSR was examined at follow-up. Participant's SRIs were calculated using 24-hour actigraphy data scored for sleep and wake. YSR T-scores of 60 or above indicate borderline clinical internalizing (n = 2) and externalizing (n = 4) symptoms at follow-up. We used linear regression modeling to determine whether baseline SRI predicted YSR scores 2 years later. Covariates included sleep start time, sleep duration, sex, and baseline YSR scores.

Results: At baseline, average SRI and YSR scores were not significantly correlated (internalizing: r = 0.10; externalizing: r = 0.24, p's > 0.1). SRI score at baseline (mean = 80.5 ± 7.4) significantly predicted YSR internalizing scores (mean = 42 ± 9) at the 2-year follow up ($t(26) = 2.57$, $p = 0.016$) but not externalizing scores (mean = 44.8 ± 10.3, $t(26) = .78$, $p = 0.44$).

Conclusion: We observed that sleep regularity was associated with internalizing symptoms two years later; however, the association was not in the expected direction: higher SRI was correlated with increased YSR internalizing scores at the 2-year follow-up. As most participants were in a healthy range for YSR scores at both assessments, a possible explanation for this finding is that those with higher SRIs have greater self-awareness in assessing their internal feelings. Future work will examine SRI values and YSR in this sample across 6 assessments acquired at 6-month intervals.

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SUBJECTIVE SLEEP QUALITY IS ASSOCIATED WITH THE REGULATION OF POSITIVE EMOTIONS

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Introduction: Sleep disturbances have been associated with emotion regulation difficulties, which in turn predicts the onset and maintenance of mental health disorders. However, research has primarily focused on the regulation of negative emotions. Associations between sleep and positive emotion regulation strategies are unknown. The current research examined relationships between subjective sleep disturbances (Study 1 and Study 2), objective sleep (Study 2), and positive emotion regulation strategies, including strategies that enhance or maintain positive emotions (i.e., savoring) and strategies that reduce positive emotion (i.e., dampening).

Methods: In Study 1, participants (N = 388, ages 18–64 years, 65% female) completed the Pittsburgh Sleep Quality Index and the Responses to Positive Affect questionnaire to assess their positive emotion regulation strategy use, which consists of three subscales (emotion-focused savoring, self-focused savoring, and dampening). Participants in Study 2 (N = 59, ages 18–30 years, 84% female) completed the Pittsburgh Sleep Quality Index, the Responses to Positive Affect questionnaire, and wore an actigraph for one week.

Results: In Study 1, greater subjective sleep disturbances were associated with increased dampening ($\beta = .45$, $B = .45$, $SE = .05$, 95% C.I. = .35, .55, $p < .001$), less emotion-focused savoring ($\beta = -.16$, $B = -.10$, $SE = .03$, 95% C.I. = -.16, -.04, $p < .005$) and less self-focused savoring ($\beta = -.16$, $B = -.08$, $SE = .03$, 95% C.I. = -.13, -.03, $p < .05$). In Study 2, subjective sleep disturbances were associated with greater dampening ($\beta = .31$, $B = .70$, $SE = .32$, 95% C.I. = .07, 1.34, $p < .05$), and marginally less self-focused savoring ($\beta = -.28$, $B = -.82$, $SE = .42$, 95% C.I. = -1.67, .02, $p = .05$). Actigraphy-measured sleep was unrelated to positive emotion regulation. All models adjusted for adjusted for age and gender.

Conclusion: Subjective sleep disturbances are associated with positive emotion regulation strategies, particularly strategies that dampen positive emotional experiences. These findings complement prior associations among sleep and the dysregulation of negative emotions, and suggest that sleep-related positive emotion dysregulation may be one mechanism by which sleep can lead to the development of emotional disorders.

Support (if any):

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EFFECTS OF METAMERIC DISPLAY-LIGHT ON ALERTNESS, VIGILANCE AND MELATONIN

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Introduction: Light emitted from visual displays can acutely increase alertness, improve cognitive performance and suppress melatonin in the evening. Here we tested the influence of different melanopic irradiance levels emitted by a metameric display setting on alertness, vigilance and salivary melatonin levels.

Methods: In an ongoing study, 37 healthy, male participants have so far completed a 2-week study protocol. Volunteers were assigned to one of four luminance groups which differed in brightness levels (27 cd/m2 - 280 cd/m2). Illuminance ranged between 7 and 85 lx. Within the four groups each volunteer was exposed to a low melanopic (LM) and a high melanopic condition (HM). The LM and HM differed in melanopic irradiance (ca. 3-fold change), but matched in terms of cone excitation (metamers). Before, during and after the light exposure, volunteers performed a psychomotor vigilance task (PVT). Subjective alertness and melatonin levels were continuously measured in half-hourly intervals throughout scheduled wakefulness in the 17-h in lab study.
Results: Preliminary analysis yielded an overall alerting response in the HM vs. the LM condition ($p<0.05$) concomitant with a trend of reduced melatonin levels in HM vs. LM ($p=0.08$). So far, we could not observe a difference in PVT performance for HM and LM (Reaction time responses between 100 and 500 ms). Since we are still lacking statistical power in the ongoing study, we cannot yet satisfactorily interpret interaction effects between melanopic condition and brightness.
Conclusion: Our data indicate that rather low brightness levels of high melanopic display light impacts alertness and melatonin levels in the evening. Thus, metameric low melanopic display light may be a promising method to attenuate activating properties of evening light on circadian physiology without affecting visual appearance.
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A RANDOMIZED FACTORIAL STUDY TO UNDERSTAND THE COMPONENTS OF BEHAVIORAL SLEEP EXTENSION

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Introduction: Recent studies have demonstrated that behavioral sleep extension can increase sleep duration among short sleepers. However, little is known about the contribution of the intervention components. The goal of this study is to examine the effects of a fitbit and coaching on sleep extension in a behavioral sleep extension intervention.
Methods: Participants included adults aged 25 to 65 years with sleep duration <7 hours who were randomized into one of four groups: self-management, Fitbit, coaching, or Fitbit + coaching. The self-management group did not receive any intervention materials. The other three groups received sleep educational materials emailed weekly. The coaching intervention (5-min telephone call) was delivered weekly for 6 weeks to the coaching and Fitbit+coaching groups to enhance motivation. Assessments were completed at baseline, post intervention (6 weeks), and 12-week follow- up. Participants completed self-report questionnaires and actigraphy at study visits. Results were analyzed using mixed models.
Results: Enrollment and data collection were ended prematurely due to the COVID-19 pandemic. Participants included 32 adults (self-management n=8, coaching n=11, Fitbit n=11, and Fitbit+coaching n=8). Fitbit+coaching group increased hours of sleep by 0.62 h hours more (95% CI: 0.04, 1.20; p=0.047) than the self-management group between their first and second visit. Coaching and the Fitbit groups showed estimated improvements over the self-management group as well: 0.54 h and 0.39 h, respectively, though their differences were not found to be statistically significant (p=0.081 and p=0.20, respectively). At the 12-week follow-up visit, there were no statistically significant differences between groups but the Fitbit+coaching group did maintain their sleep improvement.
Conclusion: These results suggest that sleep extension intervention components may affect the pattern of sleep changes, but more research is needed to refine and explore changes in sleep with behavioral interventions.
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EFFECT OF 3 CONSECUTIVE NIGHTS OF ALCOHOL ON SLEEP VARIABLES: PRELIMINARY REPORT.

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Introduction: The effects of a moderate dose of alcohol one hour before bedtime on sleep have not often been studied nor is the effect across nights well known. We therefore sought to test whether such effects as sleep disruption, increased early-night slow wave sleep (SWS), and reduced early-night REM sleep would be sustained across nights.
Methods: Twenty-five healthy participants (13 male; ages 22–69 yr, mean = 35) reporting moderate drinking kept a fixed sleep schedule (8–9 h TIB, confirmed by actigraphy) for about one week before two 3-night sleep studies in the lab separated by ≥ 3 days. Participants drank either mixer alone or a beverage containing alcohol targeting a breath alcohol content (BrAC) of 0.08% in a counter-balanced order over 45 min ending 1 hr before lights out. Sleep was scored using Rechtschaffen & Kales (1968) rules in 30-sec epochs. Mixed-effects models examined beverage type, study night, and the interaction of beverage and night for 13 variables: sleep efficiency, sleep latency, REM latency, and full-night percent of Stage 1, Stage 2, SWS, and REM sleep; and percent of SWS and REM sleep by thirds of night.
Results: A significant effect of Night was seen for sleep efficiency ($F(2,120)=3.79$; $p=.025$) and sleep latency ($F(2,120)=5.19$;$p=.007$), both lower on N1, as well as for REM latency, longer on N1 ($F(2,120)=6.52$;$p=.002$). REM latency was longer with alcohol ($F(1,120)=14.16$; $p<.000$) and no interaction was apparent. St2% was higher ($F(1,120)=4.47$; $p=.037$) and REM% lower ($F(1,120)=4.41$; $p=.038$) with alcohol, whereas overnight SWS% was unaffected; none showed an effect of night or an interaction. SWS% in the first ($F(1,120)=10.51$; $p=.002$) and second thirds ($F(1,120)=8.27$; $p=.005$) of the night was higher with alcohol and unaffected in the last third. REM% in the first third alone was higher with alcohol ($F(1,120)=10.71$; $p=.01$).
Conclusion: These findings show only modest effects of pre-sleep alcohol consumption (targeting 0.08% BrAC) on subsequent sleep in healthy drinkers, with no evidence of a cumulative impact across three nights. We aim to increase the sample size and examine effects on next-day cognitive function in subsequent analyses.
Support (if any): R01AA025593

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MEASUREMENT OF TAPPING DURING THE INTERSTIMULUS INTERVAL AS A VALIDATION METRIC FOR THE 3-MINUTE PSYCHOMOTOR VIGILANCE TEST

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Introduction: The Psychomotor Vigilance Test is a well-validated measure of sustained attention used to assess daytime alertness in sleep research studies.1 It is commonly used in a variety of research settings

due to its high sensitivity to sleep loss and absence of learning effects,2 making it an ideal tool to assess objective alertness. As some types of sleep research transition out of controlled laboratory environments, tools like the PVT require modification to maximize their reliability. The validation of the 3-minute version (PVT-B) against the 10-minute PVT is an example of this modification.3 However, considerable work is needed to improve trust in the utility of the PVT-B in and outside of traditional laboratory settings.

Methods: We carefully analyzed data from a mobile-based version of the PVT-B, noting responses that occurred during the interstimulus interval which were termed "wrong taps." Wrong taps indicated that participants were not performing the task as instructed. In some cases, wrong taps occurred across multiple trials of the same PVT block, indicative of participants repeatedly tapping the screen throughout the task to minimize response times. A comprehensive examination of wrong taps was carried out in order to identify instances where this pattern emerged.

Results: A total of 1,338,538 PVT-B trials from 7,028 participants were examined to determine the number of wrong taps present across all trials. While 91.7% of PVT-B trials were free of wrong taps, 8.3% of PVT-B trials contained 1 or more wrong taps and 5.2% contained 2 or more wrong taps. It appears that a maximum of one wrong tap per trial is acceptable and trials containing 2 or more should be excluded to maximize PVT data quality.

Conclusion: Utilizing a metric like wrong taps can help identify individuals taking the PVT-B who are tapping the screen multiple times prior to stimulus display. Closely examining this metric can help to ensure the validity of PVT-B administrations. Two possible uses of the metric could be to provide feedback during training trials and to remove trials where this strategy was employed.

Support (if any): This analysis was supported by the VA San Diego Healthcare System Research Service.

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SINGLE-PROLONGED STRESS AS A MODEL OF PTSD IN MICE: EFFECTS ON SLEEP AND ANXIETY

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Introduction: Sleep problems are common in humans with post-traumatic stress disorder (PTSD). Rapid eye movement (REM) sleep is involved in processing emotional memories; it is often disrupted in those with PTSD, and may be related to increased anxiety. Single prolonged stress (SPS) is a protocol used to model PTSD in rats, however little is known about how this model impacts sleep in mice. Prior research suggests SPS produces short term disturbances in REM sleep and increases in anxiety-like behavior, but further validation of this model is needed to understand how SPS impacts sleep and anxiety-like behaviors in mice specifically, as they have greater potential for transgenic manipulation

Methods: C57BL6/J mice underwent a SPS protocol in which they were tube-restrained for 2 hours, followed by a 15 minute forced swim in a group, ether exposure until loss of consciousness, and 10 days of social isolation. Following SPS, mice were tested for anxiety-like behavior in a light-dark box and sleep was measured from surgically implanted EEG and EMG leads. Time spent in wake, REM sleep, and non-REM sleep was quantified for 24 continuous hours in SPS and Control mice.

Results: There were no significant effects of SPS on the amount of time spent in any vigilance state, or in sleep-wake transitions. However, SPS-exposed mice showed significantly more anxiety-like behavior. EEG power spectra were analyzed in relevant frequency bands during each sleep state, and exploratory analyses were conducted

Conclusion: Minimal effects on sleep macroarchitecture were seen in mice 10 days after SPS. It is possible that sleep disturbances seen immediately after trauma exposure (such as in prior studies in rats) may have diminished over time. Further studies will need to include additional timepoints and analysis of sleep microarchitecture following SPS, and in other mouse models of PTSD, in order to more comprehensively examine changes in sleep.

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YOUNG ADULT'S SLEEP EFFICIENCY IS POSITIVELY RELATED TO RISKY DECISION- MAKING IN NOVEL BART

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Introduction: Numerous studies have indicated that poor sleep quality is relatively common among young adults and is related to less than optimal decision-making behavior. In order to assess decision-making behavior, we utilize a new variant of a Balloon Analogue Risk Task (BART) to assess sleep efficiency and other self-report measures' relation to risky decision-making in young adults. We hypothesize that individuals who have poorer sleep will make more risky decisions than those who have better sleep in a novel measure called the One-Shot BART.

Methods: 200 undergraduate participants were recruited from the University of Arizona Psychology subject pool. Participants completed sleep quality questionnaires including the Sleep Condition Indicator and Split-Week Self-Assessment of Sleep-Y. Participants also completed a battery of self-report measures to assess exposure to traumatic events and trauma-related symptoms through the PTSD Checklist and Adverse Childhood Experiences Questionnaire. Lastly, participants were also tasked with completing a novel risk-taking task measure (the One-Shot BART) to assess risk-taking propensity and elucidate the cognitive processes underlying the risk-taking behavior. This task showed a significant correlation with ($r=.24$, $p<.05$) real-world risk measures from the RISQ assessment.

Results: We found that better sleep efficiency showed a positive relationship with risk-taking($r=21$, $p<.05$) in the BART, in conflict with our initial hypothesis that better sleep would lead to less risk-taking. However, in the BART some level of risk-taking is necessary to do well in the task, so risk-taking is beneficial. We found that those people with lower levels of sleep efficiency also performed more randomly in the BART ($p<.05$), showing that a lack of sleep affects noise in the decision process, which is also supported by our finding showing that people with lower sleep efficiency also show a higher level of response time variability ($p<.05$).

Conclusion: Behavioral results from the One-Shot BART are affected by Sleep Efficiency in a college student population. Interestingly, Sleep Efficiency was positively correlated with risky decision making in the One-Shot BART, indicating more optimal risk-taking in the game that may be mirrored in real-world decisions.

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THE INFLUENCE OF SELF-REPORTED DISTRACTIONS ON THE PSYCHOMOTOR VIGILANCE TASK (PVT) IN LABORATORY AND FIELD ENVIRONMENTS

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Introduction: The Psychomotor Vigilance Task (PVT) is a measure of vigilant attention that is commonly used in laboratory environments to assess the neurobehavioral impact of sleep loss and circadian misalignment. The PVT has been increasing in popularity for use in field environments; however, the potential for distraction is higher in the field compared to the lab. It is unclear how distractions experienced by individuals taking the PVT in the real world may influence reaction time metrics. We investigated the influence of self-reported distraction on PVT outcomes across laboratory and field environments.
Methods: We examined PVT data from five studies including short (n=36 participants, 3799 PVTs) and long-haul (n=75 participants, 3282 PVTs) airline personnel, control center personnel (n=5 participants, 96 PVTs), and healthy individuals who participated in a study involving at-home and laboratory assessments (n=12 participants, 486 and 310 PVTs). Individuals in all of the studies were asked to complete the five-minute NASA PVT at least three times daily. Participants were asked to indicate the number of distractions they experienced immediately after each PVT. Mean PVT reaction time (RT) and number of distractions were computed for each study and overall.
Results: Participants reported more distractions in field environments compared to the lab (short-haul=1.29 +/- 1.48, long-haul=0.66 +/- 1.07, control-center=1.20 +/- 1.37, at-home=0.86 +/- 1.36, laboratory=0.46 +/- 1.07) Across all studies, we found that PVT RT slowed as self-reported distractions increased (all studies combined: 0 distractions=PVT RT 275.7ms; 1=285.0ms; 2=304.0ms; 3=322.9ms; >4=408.6ms). These findings were similar for healthy participants completing PVTs at home (0 distractions=286.4ms; 1=309.9ms; 2=328.3ms; 3=369.8ms; >4=385.1ms) but were less consistent during in-lab assessments (0 distractions=278.7ms; 1=316.2ms; 2=396.2ms; 3=370.4ms; >4=354.4ms). These findings were similar for other PVT outcomes.
Conclusion: Participants reported more distractions in field environments compared to the laboratory. Our findings suggest that the number of distractions that individuals report experiencing while taking a PVT increases the reaction time registered by the device. Researchers should collect information about distractions during the PVT and should be aware that distractions may influence the recorded PVT reaction time.
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SLEEP BEHAVIORS ARE DIFFERENTIALLY ASSOCIATED WITH EATING BEHAVIOR CHARACTERISTICS BASED ON SEX

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Introduction: Poor sleep health is a key determinant of obesity risk, largely explained by overconsumption of energy. Eating behavior characteristics are predictive of energy intake and weight change and may link sleep with risk factors for obesity. However, the relationships between sleep and dimensions of eating behavior, and potential individual differences in these relations, are not well characterized. Elucidating these relations may aid in the development of targeted strategies to mitigate obesity risk. Therefore, we aimed to 1) evaluate whether associations of sleep were related with eating behavior characteristics, 2) explore if these associations differed by sex.
Methods: This was a cross-sectional analysis of 179 adults aged 20–73 y (68.7% women; 64.8% with BMI≥25 kg/m2; 27.4% minority). Sleep was assessed over 2 wk using wrist actigraphy; eating behavior characteristics (dietary restraint, disinhibition and hunger) were measured with the Three-Factor Eating Questionnaire. Linear regression models were used to evaluate associations of sleep with eating behavior characteristics, adjusting for confounding variables. In separate models, sex was added as an interaction term and analyses were stratified when interactions were significant ($p<0.10$).
Results: Variable (sleep midpoint standard deviation >60 min) vs. stable sleep timing was associated with greater tendency towards hunger ($\beta=0.84 \pm 0.39$, $p=0.03$). When evaluated on the continuous scale, lower sleep efficiency ($\beta=-0.13 \pm 0.05$; $p=0.01$), longer wake after sleep onset ($\beta=0.03 \pm 0.01$; $p=0.01$) and higher sleep fragmentation index ($\beta=0.074 \pm 0.036$; $p=0.041$) were associated with higher dietary restraint. Sex influenced associations of sleep efficiency, sleep onset latency, and sleep fragmentation index with hunger. In men, but not women, lower sleep efficiency ($\beta=-0.15 \pm 0.05$; $p<0.01$), longer sleep onset latency ($\beta=0.17 \pm 0.07$; $p=0.02$) and higher sleep fragmentation index ($\beta=0.11 \pm 0.04$; $p<0.01$) were associated with greater hunger.
Conclusion: Objective measures of sleep were associated with eating behaviors previously linked with obesity and its risk factors. Moreover, we provide evidence of sex-specific associations between poor sleep and tendency towards hunger. Our results suggest that, particularly in men, differences in eating behavior traits may underlie susceptibility to overeating in response to poor sleep.
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SELF-REPORTED SLEEP AND RESILIENCE

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Introduction: Psychological resilience is the ability to withstand setbacks, adapt positively to challenges, and bounce back from the adversities of life. While the construct of resilience is broadly understood, the specific individual factors that contribute to the ability to be resilient and persevere in the face of difficulties remain poorly understood. We recently showed that psychological resilience during the COVID-19 pandemic was associated with a number of factors, including fewer complaints of insomnia, and others have suggested that sleep is an important contributor. We therefore tested the hypothesis that sleep quality and acute sleep quantity would combine to predict measures of psychological resilience and perseverance (i.e. "grit").
Methods: We asked 447 adults (18–40 yrs; 72% female) to report the number of hours of sleep obtained the night before their assessment session (SLEEP), and complete several questionnaires, including the Pittsburgh Sleep Quality Index (PSQI), the Connor-Davidson Resilience Scale (CD-RISC), Bartone Dispositional Resilience Scale (Hardiness), and the Grit Scale. Sleep metrics were used to predict resilience, hardiness, and grit using multiple linear regression.
Results: For resilience, PSQI (β=-.201, p<.00003) and SLEEP (β=.155, p<.001) each contributed uniquely to prediction of CD-RISC (R2=.08, p<.00001). Hardiness was also predicted (R2=.08, p<.00001) by a combination of PSQI (β=-.218, p<.00001) and SLEEP (β=.128, p=.007). Interestingly, worse sleep quality over the past month on the PSQI (β=.13, p=.008) in combination with more SLEEP the night before the assessment (β=.137, p=.005) each contributed uniquely to higher Grit (i.e., perseverance; R2=.03, p=.003).

Conclusion: Self-reported sleep quality and quantity were both independently associated with greater self-reported resilience, hardiness, and grit. While better sleep quality and more sleep the night before testing each uniquely predicted greater resilience and hardiness, a different pattern emerged for Grit. The combination of lower quality sleep over the past month followed by greater recent sleep duration was associated with increased perseverance. Whereas sleep quality appears to be more important for general resilience/hardiness, recent sleep time appears more important for the subjective perception of perseverance. Because these data are purely self-report and cross sectional, future work will need to determine the longitudinal effects on behavior.
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SLEEP QUALITY AND DURATION ARE ASSOCIATED WITH GREATER TRAIT EMOTIONAL INTELLIGENCE

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Introduction: Lack of sleep has been associated with altered connectivity between the emotion-regulating regions of the medial prefrontal cortex and the emotionally reactive structure of the amygdala. This altered brain function following insufficient sleep is believed to impair a range of emotional perception and regulation capacities. Our prior research has also shown that two nights of total sleep deprivation led to significant declines in Trait Emotional Intelligence (TEI) and other aspects of emotional processing and perception. Nonetheless, the extent to which general sleep quality and acute sleep duration may contribute to everyday TEI outside of laboratory conditions remains unknown. We hypothesized that poorer sleep quality and the amount of sleep obtained the night before assessment would both predict TEI scores.
Methods: 447 adults (18–40 yrs; 72% female) completed the Pittsburgh Sleep Quality Index (PSQI) and a question about the number of hours of sleep obtained the night before the assessment (SLEEP), as well as the Petrides Trait Emotional Intelligence Questionnaire (TEIQue). Sleep metrics were used to predict Total TEI, and the four TEIQue factors (Wellbeing, Self-Control, Emotionality, and Sociability) using multiple linear regression.
Results: Both PSQI (β=-.275, p<.00001) and SLEEP (β=.130, p<.00001) each contributed uniquely to prediction of Total TEI (R2=.11, p<.00001). Wellbeing was also predicted by a combination of PSQI (β=-.272, p<.00001) and SLEEP (β=.129, p=.006). In contrast, for Self-Control, only PSQI was significantly related (β=-.296, p<.00001). Both PSQI (β=-.131, p<.007) and SLEEP (β=.103, p<.034) each contributed to Emotionality. Finally, both PSQI (β=-.126, p<.010) and SLEEP (β=.107, p<.028) each contributed to Sociability.
Conclusion: Greater total TEI was uniquely predicted by a linear combination of 1) better general sleep quality over the past month and 2) greater quantity of sleep the night before the assessment session. The same pattern held for all scale factors, except Self-Control, which was only related to sleep quality over the past month. Although limited by the cross-sectional nature of the data, these findings support prior work suggesting that lack of sleep alters normal emotional processing and further suggests that both long-term sleep quality and acute restriction of sleep can affect trait-like emotional domains.
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ATTENTIONAL CONTROL DEFICITS DURING TOTAL SLEEP DEPRIVATION: INDEPENDENCE FROM REDUCED VIGILANT ATTENTION

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Introduction: Total sleep deprivation (TSD) has been shown to impair performance on a two-phase attentional control task, the AX-type continuous performance task with switch (AX-CPTs). Here we investigate whether the observed AX-CPTs impairments are a downstream consequence of TSD-induced non-specific effects (e.g., reduced vigilant attention) or reflect a distinct impact on attentional control.
Methods: N=55 healthy adults (aged 26.0±0.7y; 32 women) participated in a 4-day laboratory study with 10h baseline sleep (22:00-08:00) followed by 38h TSD and then 10h recovery sleep. At baseline (09:00 day 2) and after 25h and 30h TSD (09:00 and 14:00 day 3), subjects were tested on a 10min psychomotor vigilance test (PVT), an assay of vigilant attention, and on the AX-CPTs. The AX-CPTs required subjects to differentiate designated target from non-target cue-probe pairs. In phase 1, target trials occurred frequently, which promoted prepotent anticipatory responses; in phase 2, the target pair was switched. Accuracy of responses to various different AX-CPTs trial types was expressed relative to accuracy on phase 1 neutral (non-target cue and probe) trials, which should capture non-specific impairments on the task. For all three test sessions, these relative accuracy measures, along with accuracy on phase 1 neutral trials and lapses (RT>500ms) on the PVT, were subjected to principal component analysis (PCA).
Results: The PCA revealed three statistically independent factors. Following varimax rotation, factor 1 (36.3% variance explained) and factor 3 (14.8% variance explained) each had high loadings for relative accuracy on multiple AX-CPTs trial types from phases 1 and 2; whereas factor 2 (17.9% variance explained) had high loadings for accuracy on phase 1 neutral trials, relative accuracy on phase 1 target trials, and PVT lapses.
Conclusion: These results indicate a statistical separation between AX-CPTs phase 1 neutral trials and phase 1 target trials, in conjunction with PVT lapses, versus the various other AX-CPTs trial types. This suggests a dissociation between TSD-induced, non-specific impairments on the task—potentially related to reduced vigilant attention—and TSD-induced specific impairments related to attentional control. Thus, TSD-induced deficits in attentional control are unlikely to be a downstream consequence of non-specific impairments.
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CHEMOGENETIC SILENCING OF CORTICOTROPIN RELEASING FACTOR NEURONS IN THE PARAVENTRICULAR NUCLEUS: THE EFFECT ON POST-STRESS SLEEP

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Introduction: We have previously shown that pharmacological elevation of corticotropin releasing factor (CRF) signaling in the brain results in exacerbation of sleep disturbances evoked by the exposure of rats to an acute stressor, the dirty cage of a male rat. In the present study we (1) assessed wake-sleep behavior of mice after the exposure to the dirty cage stress paradigm, and (2) examined the effect of chemogenetic silencing of CRF neurons in the hypothalamic paraventricular nucleus (PVN) on sleep occurring following the exposure to this stressor.
Methods: First, a group of mice (n=12) was implanted with EEG/EMG electrodes. In two weeks, post-surgery, six mice were transferred to dirty cages of male rats and recorded for 24 hours. Control mice were transferred to clean cages. In the second study, a group of CRF-ires-cre mice (n=8) received bilateral injections of AAV-hSyn-DIO-hM4Di-mCherry targeting the PVN. The other group of CRF-ires-cre mice (n=8) was injected AAV-hSyn-DIO-mCherry (control vector). All mice were implanted with EEG/EMG electrodes. Dirty cage experiments were started following a 4-week postsurgical period to allow gene recombination and expression. Mice were subjected to intraperitoneal (IP) administration of clozapine-n-oxide (CNO; 3 mg/kg) at ZT1, placed into dirty cages, and recorded for post-stress sleep.
Results: Results: In mice expressing hM4Di inhibitory DREADDs (designer receptors activated by designer drugs) versus mice injected with control AAV, IP CNO (3 mg/kg) resulted in a significant decrease of post-stress sleep onset latency, decrease of time spent in wakefulness (first hour, 74±5.3 vs. 89±11.0, second hour, 37.2±10.3% vs. 81.3±9.3%; third hour, 40.1±3.3% vs. 47.1±14.3%; fourth hour, 44.4±6.0 vs. 55.5±9.9), and increase in non-rapid eye movement (NREM) sleep time (26.0±5.4% vs. 11.0±11.1%; 62.8%±9.8 vs. 18.7 ± 9.6%; 59.9±3.2% vs. 52.9±14.5%; 55.6±6.2 vs. 44.5±10.0). The hM4Di expressing mice exhibited longer episodes of NREM sleep, compared to mice injected with control AAV (first hour, 133.3±80.1sec vs. 21±1.7sec; second hour, 43256±83.4sec vs. 73.5±44.1sec; third hour, 459.2±139.8sec vs. 139±80.6sec; fourth hour, 233.1±82.6sec vs. 190±72.3sec).
Conclusion: Chemogenetic silencing of CRF neurons in the PVN attenuates acute stress-induced sleep disturbance in mice.
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PHYSIOLOGICAL CORRELATES OF THE EPWORTH SLEEPINESS SCALE REVEAL DIFFERENT DIMENSIONS OF DAYTIME SLEEPINESS.

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Introduction: The Epworth Sleepiness Scale (ESS) is used as a clinical tool for determining excessive daytime sleepiness. However, the behavior and biology that underlie ESS scores remain to be elucidated. The main objective of this analysis is to determine objective behavioral and physiologic correlates of the ESS. Secondarily, we examine the relationship of the ESS to parallel subjective and objective endpoints that could represent measures of daytime sleepiness.
Methods: Using two separate machine learning algorithms, Random Forest and Lasso, we determined the association between ESS scores and 55 sleep and medical variables in individuals who participated in the Sleep Heart Health Study (N=2105). These variables include self-reported sleep characteristics (e.g., habitual sleep length and latency, frequency of not getting enough sleep), polysomnographic sleep measures from a single night, medication use, and mental and physical health status. Additional analyses were conducted on data stratified by age and gender. To investigate the relationship between ESS and other measures of daytime sleepiness, cross-correlation analysis was conducted on the ESS and five variables that could analog daytime sleepiness (feeling unrested, nap duration and frequency, sleep latency, frequency of not getting enough sleep).
Results: Analysis of the main dataset resulted in low explained variance (7.15 - 10.0%), with self-reported frequency of not getting enough sleep as most important predictor (10.3–13.9% of the model variance). Stratification by neither age nor gender significantly improved explained variance. Habitual sleep length was not an important predictor in any model. Cross-correlational analysis revealed low correlation of other daytime sleepiness measures to ESS score.
Conclusion: Data analyses indicate that ESS scores are not well explained by habitual or polysomnographic sleep values, or a variety of other biomedical characteristics. This suggests that there are different, potentially orthogonal dimensions of the concept of "daytime sleepiness" that may be driven by different aspects of sleep physiology. Caution should be used when considering the ESS as a clinical measure given that the physiologic correlates still remain to be elucidated.
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ARTIFICIAL LIGHT-TRIGGERED SLEEP DEPRIVATION MAY LEAD TO ALLODYNIA IN RODENT MODEL

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Introduction: The combination of artificial light and lack of exposure to natural light can delay the circadian clock, dysregulate the circadian cycle, and decrease alertness upon waking. This effect has been especially significant during the COVID-19 pandemic, where overexposure to artificial light at improper hours has contributed to increased rates of clinical insomnia. Artificial light may also contribute to concomitant neurological conditions such as primary headache, but the mechanisms by which light triggers sleep deprivation-induced headache are not well-understood.
Methods: To measure pain sensitivity, we habituated 13 wild-type male mice to von Frey filaments applied to the periorbital area until there was no response to 0.6g stimulus. We then applied 5 lux of continuous dim light to mice during their usual 12-hour dark cycle. The 12-hour light cycle remained unchanged with 200 lux continuous light. Three groups of mice experienced the dim light stimulus for one, three, or five consecutive days. Ambulation and rest activity were measured using SOF-812 Activity Monitor machines. After the experiment concluded, we waited 24 hours and measured mechanical threshold using von Frey filaments at 1, 3, 5, 8, and every 3 days subsequently until mice no longer responded to 0.6g stimulus.
Results: Artificial light triggered changes in circadian behavior including increased number of rest periods during 12-hour dark (dim light) cycle and shortened sleep duration during 12-hour light cycle. Following the artificial light stimulus, there was a significant decrease in mechanical threshold ($P<0.05$), representing allodynia. The one-day group displayed one day of significant allodynia. The three-day group displayed three days of significant allodynia. The five-day group displayed five days of significant allodynia.

Conclusion: Artificial light may trigger circadian dysregulation, and the duration of artificial light exposure seemed to be directly correlated to the duration of allodynia up to one week after the stimulus was removed. We will repeat these experiments and analyze CNS and PNS tissue samples to understand the underlying physiological and biochemical bases of how artificial light triggers sleep deprivation-induced headache. This knowledge could increase our understanding of the pathophysiology and comorbidity of sleep deprivation and headache.
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CHRONIC SLEEP RESTRICTION DISRUPTS SLOW-WAVE SLEEP HOMEOSTATIC REGULATION AND DAMAGES MONOAMINERGIC STRUCTURES IN THE RAT BRAIN

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Introduction: The neurophysiological mechanisms underlying long-term neurological and cognitive disorders associated with chronic sleep restriction (CSR) are not fully understood. Here we evaluated how the sleep-wake cycle changes during and after a period of sleep restriction in rats, and whether CSR results in neurodegeneration in monoaminergic brain structures.
Methods: For CSR, 7-8-month-old Wistar rats underwent cycles of 3 h of sleep deprivation (SD) and 1 h of sleep opportunity (SO) continuously for 5 days on the orbital shaker. Telemetric sleep recordings were made before, during, and after CSR. Neurodegeneration in brain monoaminergic structures was assessed immunohistochemically.
Results: During SD, wakefulness comprised 85% of the total registration time; the remaining time was represented by drowsiness with low EEG delta power. Rapid eye movement sleep (REMS) was absent. During CSR, slow-wave sleep (SWS) and REMS were reduced by 62% and 57%. Total SWS time during SO periods increased on the first CSR day, but decreased to the baseline by the fifth CSR day. SWS EEG delta power (a measure of sleep intensity) decreased gradually from the first to the fifth CSR day. REMS total time remained elevated during all SO periods. During the first recovery day after CSR, SWS did not change, but REMS increased by 30%. No changes in total sleep time were found on the second recovery day but sleep intensity was decreased. In 14 days after CSR, all sleep parameters returned to the baseline. We revealed a loss of 24% of noradrenergic locus coeruleus neurons, 29% and 17% of dopaminergic neurons in the substantia nigra, the ventral tegmental area as well as in their striatal terminals.
Conclusion: We consider CSR as a damaging factor leading to a gradual suppression of homeostatic mechanisms governing sleep recovery. CSR can provoke neurodegeneration in monoaminergic structures involved in the regulation of emotional behavior, sleep, and autonomic functions.
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EFFECTS OF SLEEP ON INTRUSIVE SYMPTOMS AND EMOTION REACTIVITY IN A LABORATORY-BASED FILM ANALOGUE STUDY

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Introduction: Recent literature highlights the need to focus on the impact of intrusive symptoms as a possible risk factor for the development and maintenance of PTSD. Cognitive and sleep models also contribute to the further understanding of intrusive symptoms. Further emotion work emphasizes that disgust is an emotion closely associated with the emergence of posttraumatic stress symptomology following traumatic events.
Methods: This study utilized a film eliciting disgust to examine the effects of acute sleep deprivation on the intensity of intrusive symptoms and emotion reactivity. Forty-nine college students were randomly assigned to sleep as usual or an acute sleep deprivation after watching a disturbing film. It was hypothesized that, relative to the control group, participants who were acutely sleep deprived would report higher frequency of intrusive symptoms and higher negative valence.
Results: Findings were partially consistent with hypotheses. There were no group or interaction effects on intrusive symptoms, although participants across both groups reported significant decreases in negative valence and intrusive symptoms across the study ($F(1, 47) = 10.30$, $p < 0.01$). There was a significant interaction effect between sleep group and self-reported negative valence, where individuals in the sleep deprived group reported significantly higher valence than individuals in the control group, despite significant decreases in negative valence over time ($F(1, 48) = 7.869$, $p < 0.01$).
Conclusion: Possible mechanisms that may contribute to the significant difference in valence may be due to higher order emotion regulation strategies that are compromised due to sleep loss. However, the significant decreases in negative valence and intrusive symptoms over time may be due to methodological factors or the type of sleep manipulation. Further work can address these challenges by using a larger sample size or examining the effects of chronic, partial sleep deprivation.
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STABILITY OF GUT MICROBIOME ALPHA DIVERSITY DURING COMBINED SLEEP RESTRICTION AND CIRCADIAN MISALIGNMENT

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Introduction: Disturbed gut microbiome diversity has been associated with poor health outcomes and various disease states. We investigated the impact of combined sleep restriction (3h time in bed [TIB] sleep opportunities per day) and circadian misalignment (daytime sleep and nighttime wakefulness) on gut microbiome alpha diversity in healthy young individuals in a controlled laboratory setting.
Methods: Twenty healthy adults (8 female), mean age (±SD) 25.65(±4.2) completed a 39-day protocol consisting of two laboratory visits lasting 4 days each. Two weeks of ambulatory monitoring prior to laboratory visits confirmed ~8h habitual sleep duration per night. Participants consumed energy-balanced diets, identical within participants, 2 days before and during the laboratory visits. The laboratory visits consisted of sleep opportunities as follows: night 1 (8h TIB), night 2 (3h TIB), day 3 (3h TIB) and day 4 (3h TIB). Fecal microbiome samples were obtained at baseline between day 1 and 2, and during sleep and circadian disruption (between day 3 and 4). Alpha diversity measures were calculated using Pielou's evenness, Faith's phylogenetic diversity and number of observed OTUs.
Results: Linear mixed models with subject as a random factor and visit as a fixed factor were performed to assess whether any alpha diversity measures changed during sleep and circadian disruption compared to baseline. Alpha diversity did not change significantly between baseline and sleep and circadian disruption (all $p > 0.57$). Additionally, intraclass correlation coefficients (ICCs) were calculated at baseline and during sleep and circadian disruption to determine if alpha diversity measures showed trait-like stability at both time points. ICCs were substantial to almost perfect (ICC 0.64–0.84) at baseline and substantial (ICC 0.70–0.80) during sleep and circadian disruption.
Conclusion: Four days of combined sleep restriction and circadian misalignment does not appear to alter alpha diversity of gut microbiota species in healthy adults. Further, substantial to almost perfect intraclass correlation coefficients suggest alpha diversity of the human microbiome is stable during combined sleep and circadian perturbation and that examination at the level of microbiota community composition and functional outcomes are needed.
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AGE AND SEX DIFFERENCES IN BEHAVIORAL ATTENTION ACROSS BASELINE, SLEEP LOSS, AND RECOVERY

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Introduction: There are established individual differences in performance resulting from sleep loss. However, differences in behavioral attention performance between demographic subgroups remain unclear, especially during recovery after sleep loss. Thus, we examined demographic subgroup performance differences during baseline, sleep loss (sleep restriction [SR] and total sleep deprivation [TSD]), and recovery (R).
Methods: Forty-one healthy adults participated in a 13-night experiment (2 baseline nights [10h-12h time-in-bed, TIB], 5 SR nights [4h TIB], 4 recovery nights [12h TIB], and 36h TSD). The 10-minute Psychomotor Vigilance Test (PVT), measuring behavioral attention, was administered every 2h during wakefulness. PVT lapses (reaction time [RT]>500ms) and 1/RT (response speed) were measured. PVT performance differences were investigated by sex (18 females) and by median split on age (range: 21-49y; median: 32y). Repeated measures ANOVAs on each study day examined PVT performance with demographic groups as the between-subject factor.
Results: SR1-2 and R1-2 showed significant between-subject effects by age: the older group had faster mean 1/RT than the younger group. SR2 showed a significant time*age group interaction: the older group had faster 1/RT from 0800h-1400h. B2, SR1, and R1 showed significant between-subject effects by sex: males had faster mean 1/RT than females. SR3 showed a significant time*sex interaction: males had faster 1/RT at 0800h and 1200h. PVT lapses (log transformed) analyses by age and by sex revealed significant between-subject effects at SR1 and R1. The direction of effects for lapses paralleled those for 1/RT: the younger group and females had more lapses than the older group and males, respectively. No other study days showed significant between-subjects or interaction effects.
Conclusion: For both age and sex, significant between-subject effects and/or interactions were revealed only in the beginning half of SR or recovery and not during TSD. These findings suggest that group differences exist when the effects of sleep loss are mild (i.e., SR1-3) or when the post-effects of sleep loss have diminished (i.e., R3-4); however, when the effects of sleep loss become more severe (i.e., SR4-5 or after a night of TSD), the well-established individual differences in response to sleep loss may overwhelm group differences.
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BEHAVIORAL ATTENTION RAW SCORES BEST DIFFERENTIATE COGNITIVE RESILIENCE AND VULNERABILITY TO SLEEP LOSS

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Introduction: There are substantial, stable individual differences in cognitive performance resulting from sleep restriction (SR) and total sleep deprivation (TSD). The best method for defining cognitive resilience and vulnerability to sleep loss remains an unanswered, yet important question. To investigate this, we compared multiple approaches and cutoff thresholds to define resilience and vulnerability using the 10-minute Psychomotor Vigilance Test (PVT).
Methods: Forty-one healthy adults (ages 21-49; mean±SD, 33.9±8.9y; 18 females) participated in a 13-night experiment [2 baseline nights (10h-12h time-in-bed, TIB), 5 SR nights (4h TIB), 4 recovery nights (12h TIB), and 36h TSD]. The PVT was administered every 2h during wakefulness. PVT lapses (reaction time [RT]>500 ms) and 1/RT (response speed) were measured. Resilient and vulnerable groups were defined by three approaches: average performance during SR1-5, average performance change from baseline to SR1-5, and variance in performance during SR1-5. Within each approach, resilient/vulnerable groups were defined by +/- 1 standard deviation and by the top and bottom 12.5%, 20%, 25%, 33%, 50%. Bias-corrected and accelerated bootstrapped t-tests compared PVT performance between the resilient and vulnerable groups during baseline and SR1-5. Kendall's tau correlations compared the ranking of individuals in each group.

Results: T-tests revealed that the resilient and vulnerable PVT lapses groups, defined by all three approaches, had significantly different mean PVT lapses at all cutoffs. Resilient and vulnerable PVT 1/RT groups, defined by raw scores and by change from baseline, had significantly different mean PVT 1/RT at all cutoffs. However, resilient/vulnerable PVT 1/RT groups defined by variance only differed at the 33% and 50% cutoffs. Notably, raw scores at baseline significantly differed between resilient/vulnerable groups for both PVT measures. Variance vs. raw scores and variance vs. change from baseline had the lowest correlation coefficients for both PVT measures.
Conclusion: Defining resilient and vulnerable groups by raw scores during SR1-5 produced the clearest differentiation between resilient and vulnerable groups at every cutoff threshold for PVT lapses and response speed. As such, we propose that using PVT raw score is the optimal approach to define resilient and vulnerable groups for behavioral attention performance during sleep loss.
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COMPARISON OF VARIOUS METHODS TO DIFFERENTIATE RESILIENCE AND VULNERABILITY TO SLEEP LOSS USING SELF-RATED MEASURES

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Introduction: There are robust, trait-like individual differences in subjective perceptions in response to sleep restriction (SR) and total sleep deprivation (TSD). How to best define neurobehavioral resilience and vulnerability to sleep loss remains an open question. We compared multiple approaches and cutoff thresholds for defining resilience and vulnerability using scores on the Karolinska Sleepiness Scale (KSS) and the Profile of Mood States Fatigue and Vigor (POMS-F and POMS-V) subscales.
Methods: Forty-one adults (33.9±8.9y;18 females) participated in a 13-night experiment (two baseline nights [10h-12h time in bed, TIB], 5 SR nights [4h TIB], 4 recovery nights [12h TIB], and 36h TSD). The KSS, POMS-F, and POMS-V were administered every 2h during wakefulness. Resilience and vulnerability were defined by the following: average score during SR1-5, average change from baseline to SR1-5, and variance during SR1-5. Resilient and vulnerable groups were defined by the following cutoffs: the top and bottom 12.5%, 20%, 25%, 33%, 50%, and +/-1 standard deviation. Bias-corrected and accelerated bootstrapped t-tests compared the scores of resilient and vulnerable groups during baseline and across SR1-5. Kendall's tau correlations compared the ranking of individuals in each group (tau=0.4:moderate,0.7:strong).
Results: Resilient and vulnerable groups for POMS-F, as defined by all three approaches, significantly differed in their scores at all cutoffs during SR. However, only raw score and change from baseline approaches defined significantly different resilient and vulnerable groups during SR for KSS, and only raw score and variance approaches defined significantly different groups during SR for POMS-V. Notably, raw scores at baseline significantly differed between resilient and vulnerable groups for all measures. Correlations revealed moderate to strong associations between all three approaches at all cutoffs for POMS-F, between raw score and change from baseline approaches for KSS, and between raw score and variance approaches for POMS-V.
Conclusion: Defining resilience and vulnerability on self-rated measures by change from baseline was comparable to using raw score for KSS and POMS-F, whereas defining these groups by variance was comparable for POMS-F and POMS-V. Differences across methods may be due to the differential impact of SR on these various distinct subjective states.
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RELATIONSHIPS BETWEEN PERCEPTIONS OF SUBJECTIVE STATES DIFFER BY SLEEP LOSS AND DURING RECOVERY IN HEALTHY ADULTS

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Introduction: The Karolinska Sleepiness Scale (KSS) and the Profile of Mood States Fatigue and Vigor subscales (POMS-F and POMS-V) are commonly used to assess subjective sleepiness, fatigue and vigor in response to sleep loss. However, the detailed time course of relationships between these measures across sleep loss and recovery remains unknown yet is critical for assessing varying changes in perception of subjective states. Repeated measures correlation (rmcorr) examined within-individual association between the measures throughout a highly controlled sleep deprivation study.
Methods: Forty-one healthy adults (ages 21-49; mean±SD, 33.9±8.9y; 18 females) participated in a 13-night experiment consisting of two baseline nights (10h-12h time-in-bed, TIB) followed by 5 sleep restriction (SR) nights (4h TIB), 4 recovery nights (12h TIB), and 36h total sleep deprivation (TSD). A neurobehavioral test battery, including the KSS, POMS-F, and POMS-V, was administered every 2h during wakefulness. Rmcorr compared KSS, POMS-F, and POMS-V scores by examining correlations by study day (e.g., Baseline day 2) and by time point (e.g., 1000h-2000h). Rmcorr cutoffs were as follows: r=0.1:small, 0.3:moderate, 0.5:large.
Results: KSS and POMS-F maintained positive correlations throughout the study, whereas POMS-F and POMS-V and KSS and POMS-V were inversely correlated. All correlations were significant except those for POMS-F and POMS-V across recovery day 1 and KSS and POMS-F across recovery day 4. All measure pairs showed moderate to large correlations across baseline and SR1-5, but only small to moderate correlations across recovery. KSS and POMS-F and KSS and POMS-V showed moderate to large correlations across TSD; however, POMS-F and POMS-V only showed a small correlation. All three pairs showed consistent moderate (POMS-F and POMS-V) or large (KSS and POMS-F, KSS and POMS-V [moderate at 2000h]) correlations when analyzed by time point across the study.
Conclusion: Overall, the strength of relationships between KSS, POMS-F, and POMS-V scores varied as a function of type of sleep loss (SR or TSD) and by fully rested states, but not by time of day. This demonstrates the importance of determining perceptions of sleepiness, fatigue, and vigor in relation to each other, especially during recovery for all three constructs.
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BEHAVIORAL ATTENTION AND SLEEPINESS DISPLAY ROBUST STABLE RELATIONSHIPS ACROSS SLEEP LOSS BUT NOT ACROSS RECOVERY

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Introduction: The 10-minute and 3-minute versions of the Psychomotor Vigilance Test (PVT10 and PVT3) and the Karolinska Sleepiness Scale (KSS) are commonly used to assess objective behavioral attention deficits and subjective sleepiness in response to sleep loss, respectively. However, the precise time course of relationships between behavioral attention and subjective sleepiness across sleep loss and recovery remains unknown but is critical for determining whether objective and subjective measures track each other. Repeated measures correlation (rmcorr) examined within-individual association between these measures throughout a highly controlled sleep deprivation study.
Methods: Forty-one healthy adults (ages 21-49;mean±SD, 33.9±8.9y;18 females) participated in a 13-night experiment consisting of two baseline nights (10h-12h time-in-bed, TIB) followed by 5 sleep restriction (SR) nights (4h TIB), 4 recovery nights (12h TIB), and 36h total sleep deprivation (TSD). A neurobehavioral test battery, including the PVT10, PVT3, and KSS, was administered every 2h during wakefulness. Rmcorr compared PVT10 [lapses (reaction time [RT] >500ms) and 1/RT (response speed)], PVT3 (lapses [RT>355ms], 1/RT), and KSS scores by examining correlations by day (e.g., Baseline day 2) and time point (e.g., 1000h-2000h). Rmcorr ranges: r=0.1:small; r=0.3:moderate; r=0.5:large.
Results: Generally, the correlations between the PVT10 and KSS and the PVT3 and KSS showed a similar pattern for lapses and 1/RT. PVT lapses and KSS scores showed small or non-significant correlations during baseline and recovery, whereas SR and TSD showed moderate correlations. PVT 1/RT and KSS scores showed moderate correlations during baseline, moderate to large correlations during SR and TSD, but small correlations during recovery. PVT10 and PVT3 1/RT showed stronger correlations with KSS scores than lapses. Additionally, all relationships showed moderate to large correlations by time point across the study.
Conclusion: Overall, the relationship between behavioral attention and sleepiness was stronger across sleep loss (SR or TSD) relative to fully rested states while it was consistently relatively strong at specific times of day throughout the study. In contrast to published literature, there is a remarkably stable relationship between an individual's objective behavioral attention performance and perceptions of sleepiness during sleep loss, which is not evident during recovery or at baseline.
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SEEKING TREATMENT FOR DAYTIME SLEEPINESS: BELIEFS AND ATTITUDES AMONG PEOPLE WITH EXCESSIVE DAYTIME SLEEPINESS

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Introduction: Sleepiness impacts health and functioning, but many people with sleepiness do not seek care. Beliefs and attitudes about treatments for sleepiness may be useful to know in designing and targeting interventions.
Methods: N=28 participants with excessive daytime sleepiness (ESS>=10) but no other major medical problems were recruited from the community. They were administered an Epworth Sleepiness Scale and Fatigue Severity Scale at baseline, and asked about a wide range of beliefs/attitudes about seeking medical care about sleepiness, and whether they Strongly Agree (SA), Agree (A), Disagree (D), or Strongly Disagree (SD) with them. Ordinal logistic regressions examined agreement associated with baseline sleepiness and fatigue, adjusted for age, sex, and race/ethnicity. Nominal significance was determined as $p<0.05$.
Results: Rates of baseline agreement were as follows: People with insomnia (SA:50%,A:50%), sleep apnea (SA:68%,A:32%), and daytime sleepiness (SA:50%,A:36%,D:14%) "should discuss their problems with their doctor or health care provider.""I have talked to my doctor about sleep problems"(SA:18%,A:23%,D:41%,SD18%). "I have talked to my doctor about daytime sleepiness (SA:23%,A:14%,D:45%,SD:18%). "If I had problems sleeping, I would discuss it with my doctor or health care provider" (SA:27%,A:50%,D:23%). "If I had problems with daytime sleepiness, I would discuss it with my doctor or health care provider" (SA:23%,A:50%,D:27%). "Excessive daytime sleepiness is something that can be improved with medical treatment"(SA:14%,A:55%,D:32%). "Excessive daytime sleepiness is something that can be improved with psychological treatment" (SA:9%,A:64%,D:27%). "Excessive daytime sleepiness is something that can be improved with complementary/alternative medicine treatment" (SA:9%,A:68%,D:18%,SD:5%). "I am concerned about side effects of medical treatments for daytime sleepiness" (SA:45%,A:42%,D:14%). These factors were not associated with baseline sleepiness. Those with higher baseline fatigue were more likely to report having talked to their doctor about sleepiness (oOR=1.33, p=0.02) and having talked to their doctor about sleep problems in general (oOR=1.54, p=0.02).
Conclusion: Real-world beliefs and attitudes about treatments for sleepiness reflect a general positive attitude towards addressing these issues with medical providers, not a very strong one. Side effects of medications are a common concern. Baseline fatigue may spur individuals to talk to their doctor.
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BEHAVIORAL ATTENTION RELATIONSHIPS VARY BETWEEN DEMOGRAPHIC GROUPS ACROSS SLEEP LOSS AND RECOVERY

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Introduction: The Psychomotor Vigilance Test (PVT) is a behavioral attention measure widely used to describe sleep loss deficits. Although there are reported differences in PVT performance for various demographic groups, no study has examined the relationship between measures on the 10-minute PVT (PVT10) and the 3-minute PVT (PVT3) within sex, age, and body mass index (BMI) groups throughout a highly controlled sleep deprivation study.
Methods: Forty-one healthy adults (mean±SD ages, 33.9±8.9y) participated in a 13-night experiment [2 baseline nights (10h-12h time in bed, TIB) followed by 5 sleep restriction (SR1-5) nights (4h TIB), 4 recovery nights (R1-R4; 12h TIB), and 36h total sleep deprivation (TSD)]. A neurobehavioral test battery, including the PVT10 and PVT3 was completed every 2h during wakefulness. Repeated measures correlation (rmcorr) compared PVT10 and PVT3 lapses (reaction time [RT] >355ms [PVT3] and >500ms [PVT10]) and response speed (1/RT) by examining correlations by day (e.g., baseline day 2) and time point (e.g., 1000h-2000h) within sex groups (18 females), within age groups defined by a median split (median=32, range=21-49y), and within BMI groups defined by a median split (median=25, range=17-31).
Results: PVT10 and PVT3 1/RT was significantly correlated at all study days and time points excluding at baseline for the younger group and at R2 for the higher BMI group. PVT10 and PVT3 lapses showed overall lower correlations across the study relative to 1/RT. Lapses were not significantly correlated at baseline for any

group, for males across recovery (R1-R4), for the high BMI group at R2-R4, for the older group at R2-R3, or for the younger group at SR5 or R3.

Conclusion: Differentiating participants based on age, sex, or BMI revealed important variation in the relationship between PVT10 and PVT3 measures across the study. Surprisingly, lapses were not significantly correlated at baseline for any demographic group or across recovery for males or the high BMI or older group. Thus, PVT10 and PVT3 lapses may be less comparable in certain populations when well-rested. These findings add to a growing literature suggesting demographic factors may be important factors to consider when evaluating the effects of sleep loss.

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DIFFERENT DURATION PSYCHOMOTOR VIGILANCE TESTS SHOW ROBUST STABLE RELATIONSHIPS ACROSS SLEEP LOSS THAT DETERIORATE IN RECOVERY

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Introduction: The Psychomotor Vigilance Test (PVT), a behavioral attention measure widely used to capture sleep loss deficits, is available in 10-minute (PVT10) and 3-minute (PVT3) versions. The PVT3 is a briefer and presumably comparable assessment to the more commonly used PVT10 yet the relationship between the measures from the two versions across specific time points and in recovery after sleep loss has not been investigated. Repeated measures correlation (rmcorr) evaluated within-individual associations between measures on the PVT10 and PVT3 throughout a highly controlled sleep deprivation study.

Methods: Forty-one healthy adults (ages 21-49; mean±SD, 33.9±8.9y; 18 females) participated in a 13-night experiment consisting of 2 baseline nights (10h-12h time in bed, TIB) followed by 5 sleep restriction (SR1-5) nights (4h TIB), 4 recovery nights (R1-R4; 12h TIB), and 36h total sleep deprivation (TSD). A neurobehavioral test battery, including the PVT10 and PVT3 was completed every 2h during wakefulness. Rmcorr compared PVT10 and PVT3 lapses (reaction time [RT] >355ms [PVT3] or >500ms [PVT10]) and response speed (1/RT) by examining correlations by day (e.g., baseline day 2) and by time point (e.g., 1000h-2000h). Rmcorr ranges were as follows: 0.1-0.3, small; 0.3-0.5, moderate; 0.5-0.7, large; 0.7-0.9, very large.

Results: All time point correlations (1000h-2000h) were significant (moderate to large for lapses; large to very large for 1/RT). Lapses demonstrated large correlations during R1, moderate correlations during SR1-SR5 and TSD, and small correlations during R2 and R4, and showed no significant correlations during baseline or R3. 1/RT correlations were large for SR1-SR4 and TSD, moderate for SR5 and R1-R4, and small for baseline.

Conclusion: The various PVT relationships were consistently strong at specific times of day throughout the study. In addition, higher correlations observed for 1/RT relative to lapses and during SR and TSD relative to baseline and recovery suggest that the PVT10 and PVT3 are most similar and best follow performance when most individuals are experiencing behavioral attention deficits during sleep loss. Both measures track SR and TSD performance well, with 1/RT presenting as more comparable between the PVT10 and PVT3.

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DETRIMENTAL EFFECTS OF ACUTE SLEEP DEPRIVATION ON PERCEPTUAL METACOGNITION

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Introduction: Sleep deprivation (SD) impairs cognitive performance but its impact on metacognition – i.e. the ability to introspect about cognitive performance – is less clear. A few studies have assessed metacognitive accuracy after acute sleep deprivation in tasks of executive functions and found no impairments. However, whether SD has no influence on metacognition of other cognitive domains such as perception has not been investigated. In this study, we examined how metacognitive accuracy in perceptual decision tasks is affected by 32 hours of sustained wakefulness.

Methods: 14 participants (3 males, aged 20-32) repeated four visual psychophysical tasks (orientation discrimination, two-flicker fusion, vernier acuity and a novel face/house discrimination in noise) at regular intervals during 32 hours of sustained wakefulness and once after 8 hours recovery sleep. In each task, we concurrently measured quantitative indices of perceptual threshold, confidence rating and metacognitive accuracy (i.e. how well confidence ratings discriminate correct vs incorrect perceptual judgements).

Results: We observed a gradual increase of perceptual threshold in all tasks with increased time awake. Furthermore, metacognitive accuracy gradually decreased during sustained wakefulness in all tasks. Specifically, the decrease in metacognitive accuracy was driven by over-estimated confidence in trials when participants made incorrect perceptual judgements. After recovery sleep, perceptual thresholds were reset to baseline for all tasks, while metacognitive accuracy was reset to baseline for the orientation discrimination and two-flicker fusion tasks only.

Conclusion: We showed that sustained wakefulness up to 32 hours increasingly impairs metacognitive accuracy in perceptual decision tasks. These results are consistent across different perceptual tasks, but are in contrast to previous studies showing preserved metacognition of executive functions after SD. Overall, this suggests that the fundamental mechanisms of perceptual metacognition may be similarly affected by sleep deprivation, but that SD selectively impacts different domains of metacognition, such as perceptual metacognition and metacognition of executive functions.

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SKELETAL MUSCLE RNA AND INSULIN SENSITIVITY DURING INSUFFICIENT SLEEP

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Introduction: Insufficient sleep is associated with a down-regulation of genes involved in glycolysis, in conjunction with an upregulation of genes involved in lipid metabolism in skeletal muscle. However, whether changes in RNA are associated with impairments in insulin sensitivity is unclear. We therefore tested the hypothesis that insufficient sleep will induce alterations in skeletal muscle RNA that correlate with changes in insulin sensitivity.

Methods: As part of an ongoing study, sixteen sedentary, healthy, lean adults (24.9±3.4y; 22.6±1.7kg/m2; 6F; mean±SD) participated

in a controlled 6-day in-laboratory protocol with 9h in bed (habitual sleep) followed by 4 nights of 5h in bed (insufficient sleep), achieved by delaying bedtime by 4 hours. For one week prior to the study, participants maintained a 9h sleep schedule based on their habitual bed and wake times. Participants consumed energy-balanced diets 3 days prior to and throughout the laboratory protocol. Whole body insulin sensitivity was assessed using glucose infusion rate from a hyperinsulinemic euglycemic clamp before and after 4 nights of insufficient sleep. Skeletal muscle biopsies of the vastus lateralis were taken immediately before each clamp. In a subset of subjects (n=12), RNA sequencing was performed (Novogene Co., Ltd). Generalized linear model likelihood ratio tests were completed using the DESeq2/EdgeR R packages with a false discovery rate (FDR) cut-off of 5%. P-values were adjusted for multiple comparisons using the Benjamini-Hochberg method and a corrected p-value of 0.05 and log2 fold-change of 0 were set as the threshold for statistical significance.

Results: Insulin sensitivity was impaired by 6% following insufficient sleep (10.1±1.4 vs 9.1±1.1mg/kg/min, p<0.05, mean±SEM). Preliminary results from skeletal muscle RNAseq analyses suggest approximately 25 genes were down-regulated and 60 genes were up-regulated. Down-regulated genes were involved in insulin-like growth factor binding and signal transduction (p=8.4e-11), while up-regulated genes were involved in glycolysis and ATP binding (p=1.1e-9). While there were trends for associations between changes in gene expression and insulin sensitivity, these relationships did not reach statistical significance.

Conclusion: Preliminary findings suggest insufficient sleep alters skeletal muscle RNA. Changes in these aforementioned pathways may contribute to metabolic dysregulation during insufficient sleep.

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INCREASED PLASMA RENIN ACTIVITY DURING WAKE IN A REPETITIVE SLEEP RESTRICTION PROTOCOL

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Introduction: Insufficient sleep is associated with an increased risk of hypertension. It is well established that long-term BP regulation is modulated by the renin-angiotensin-aldosterone system (RAAS) and chronic kidney disease is a strong independent risk factor for development of cardiovascular disease. This study investigated the biomarkers of RAAS and renal function during repetitive exposures to controlled, experimental sleep restriction (SR). We hypothesized an upregulation of RAAS and increased markers of impaired renal function.

Methods: Twenty-one healthy participants (11 women, average age 31±2 years) completed the 22-day in-hospital SR protocol: permitted 4h of sleep/night from 0300-0700 for 3 nights followed by a recovery sleep, repeated 4 times. Blood samples were collected and plasma renin activity (PRA) was assessed in the morning (7:05am) and in the evening before bedtime (22:45pm) at baseline, experimental days (3rd day of each of the 4 blocks), and recovery. Urinary albumin to creatinine ratio (ACR) was measured from 24-h urinary collection at baseline, first and fourth SR blocks. Estimated glomerulus filtration rate (eGFR) was calculated based on the serum cystatin C levels at baseline and last block of SR.

Results: Percent change of evening PRA significantly increased during 4 blocks of SR and recovery (SR effect p=0.039), but not morning PRA (SR effect p=0.34). Specifically, evening PRA increased up to 98.4% in the first (p<0.01), 61.3% in the second (p=0.04) SR blocks, and 57.5% (p=0.05) in recovery. Urinary ACR showed no significant changes during first or fourth SR blocks (SR effect p=0.28). In addition, eGFR did not change in the fourth SR block compared to BL (paired t-test, p=0.27).

Conclusion: We did not see increased markers of impaired renal function (ACR or eGFR). Rather, short-term repetitive exposures to SR significantly increased percent change of PRA measured before bedtime, and evening PRA did not return to BL level during recovery. Our results suggested that sleep deficiency may contribute to hypertension through upregulation of RAAS during wake time.

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EXPOSURE TO SIMULATED MILITARY OPERATIONAL STRESS DECREASES ALERTNESS IN THE MORNING BUT NOT THE EVENING

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Introduction: Alertness, essential for optimal performance, may be modulated by acute stressors including: sleep loss, caloric restriction, cognitive load, and physical exertion. Prior sleep may attenuate sleep loss-related alertness decrements, thereby influencing performance and safety. We examined the effects of prior sleep and changes in alertness throughout the day and across days during a simulated military operational stress (SMOS) protocol.

Methods: As part of a 5-day SMOS protocol, fifty-eight active-duty or recently-separated military personnel (45 men; 26±6 years) completed subjective (Profile of Mood States, Vigor subscale) and objective (3-minute Psychomotor Vigilance Task; PVT) alertness assessments each morning (~0900) and evening (~2200). PVT outcomes included median reaction time (RT) and lapses. Day 2 (D2) reflected baseline testing, in which participants received an 8-hour sleep opportunity (2300-0700) and 100% of their estimated caloric need. Day 4 (D4) reflected peak stress, after two nights of participants receiving two 2-hour sleep opportunities (0100-0300, 0500-0700) and 50% of their estimated caloric need. Mixed effects ANOVAs were used to assess the effects of day (D2, D4) and time (Morning, Evening) on alertness. D2 and D4 reflected alertness at baseline and peak stress, respectively. Separate ANOVAs were performed to assess the effects of prior sleep: the Pittsburgh Sleep Quality Index (PSQI) assessed at intake, baseline polysomnography-measured sleep efficiency (SE), and baseline frontal slow wave activity (SWA; 0.5-4Hz). All analyses controlled for age.

Results: No significant interaction or main effects of day and time were found for Vigor or PVT lapses. Participants with higher PSQI scores reported lower Vigor (p=.01, η_p^2=.11). A significant interaction was found for PVT RT (p=.04, η_p^2=.07); morning RT was slower on D4 than D2, while evening RT did not differ across days. SE and SWA did not significantly influence alertness.

Conclusion: SMOS led to objective alertness deficits in the morning but not evening. Subjective alertness did not change during SMOS but was influenced by prior sleep quality (PSQI). Thus, both circadian and prior sleep-related factors influence performance during operational stress. Fatigue mitigation strategies delivered before and during military operations may support performance and safety.

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COGNITIVE THROUGHPUT, BEHAVIORAL ATTENTION, AND SLEEPINESS SHOW ROBUST RELATIONSHIPS DURING SLEEP LOSS BUT NOT DURING RECOVERY

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Introduction: The Digit Symbol Substitution Task (DSST) is a frequently used measure to determine cognitive throughput responses to sleep loss. However, the specific time course of relationships between cognitive throughput and behavioral attention [using the 10-minute Psychomotor Vigilance Test (PVT10)] and subjective sleepiness [using the Karolinska Sleepiness Scale (KSS)] across sleep loss and recovery remains unknown yet is critical for assessing whether tasks involving learning and those without learning track each other. Repeated measures correlation (rmcorr) examined within-individual associations between measures of these tests throughout a highly controlled sleep deprivation study.

Methods: Forty-one healthy adults (ages 21-49;mean ± SD, 33.9 ± 8.9y;18 females) participated in a 13-night experiment consisting of two baseline nights (10h-12h time in bed, TIB) followed by 5 sleep restriction (SR) nights (4h TIB), 4 recovery nights (12h TIB), and 36h total sleep deprivation (TSD). A neurobehavioral test battery, including the DSST, the KSS, and the PVT10, was administered every 2h during wakefulness. Rmcorr analyses compared DSST [number correct], KSS score, and PVT10 performance [lapses (reaction time [RT] >500ms) and 1/RT (response speed)] by examining correlations by day (e.g., Baseline day 2) and by time point (e.g., 1000h-2000h). Rmcorr ranges were as follows: r=0.1: small; r=0.3: moderate; r=0.5: large.

Results: During SR and TSD, correlations were significant, ranging from moderate to large, with the strongest correlation occurring during TSD. By contrast, baseline and recovery correlations were not significant or were small for DSST relative to PVT10 lapses, PVT10 response speed, or KSS scores. Additionally, all three pairs showed moderate to large correlations by time point across the entire study.

Conclusion: The various test measure relationships were consistently strong at specific times of day throughout the study. In addition, the associations between cognitive throughput and behavioral attention and sleepiness were strongest during sleep loss, particularly during TSD, suggesting that these measures are most acutely attuned to neurobehavioral changes resulting from sleep loss. The lack of a significant relationship at baseline and at recovery may be due to the learning effect reported for the DSST that is not present for the PVT10 or KSS.

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RAW SCORES BEST DIFFERENTIATE RESILIENCE AND VULNERABILITY TO SLEEP LOSS FOR COGNITIVE THROUGHPUT AND WORKING MEMORY

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Introduction: Substantial individual differences exist in cognitive deficits due to sleep restriction (SR) and total sleep deprivation (TSD), but the best approach to define such resilience and vulnerability remains a critical question. We compared multiple approaches and cutoff thresholds to define resilience and vulnerability using the Digit Symbol Substitution Task (DSST) and the Digit Span Task (DST).

Methods: Forty-one healthy adults (mean±SD ages,33.9±8.9y) participated in a 13-night experiment [two baseline nights (10h-12h time-in-bed, TIB), 5 SR nights (4h TIB), 4 recovery nights (12h TIB), and 36h TSD]. The DSST [measuring cognitive throughput] and DST [measuring working memory] were administered every 2h during wakefulness. Resilient/vulnerable groups were defined by average performance (DSST: number correct; DST: total correct from forward and backward versions) during SR1-5, average performance change from baseline during SR1-5, and variance in performance during SR1-5. Within each approach, groups were defined by +/-1 standard deviation (SD) and the top and bottom 12.5%, 20%, 25%, 33%, 50%. Bias-corrected and accelerated bootstrapped t-tests compared performance between resilient and vulnerable groups during baseline and SR1-5. Kendall's tau correlations compared the ranking of individuals in each group.

Results: T-tests showed significant differences between resilient/vulnerable groups at all raw score cutoffs for DSST and DST performance during SR and at baseline. Change from baseline t-tests showed significant differences during SR between the DSST groups only at 12.5%, 20%, and SD whereas DST t-tests showed significant differences at all cutoffs. Variance t-tests revealed a significant difference between the DSST groups only at 25% during SR. For the DSST, the variance vs. change from baseline comparison at all cutoffs and between raw score vs. change from baseline for the SD cutoff showed moderate correlations, and for the DST, the raw score vs. change from baseline correlation was moderate for 25% and 33%.

Conclusion: The resilient/vulnerable groups defined by raw score were more consistent than those defined by change from baseline or variance, and raw score did not track these approaches well. As such, raw score is the optimal approach to define cognitive throughput and working memory performance resiliency/vulnerability during sleep loss.

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GREATER NREM SLEEP REBOUND IN RESPONSE TO EXPERIMENTAL SLEEP DISTURBANCE ASSOCIATED WITH HIGHER INFLAMMATORY RESOLUTION IN HUMANS

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Introduction: Sleep disturbances deteriorate immune function by not only affecting pro-inflammatory pathways, but also inflammatory resolution pathways, which actively terminate inflammation. It is assumed that slow wave sleep (SWS) amount and slow wave activity (SWA) convey the immune-supportive functions of sleep. We investigated whether changes in SWS induced by experimental sleep disturbance followed by recovery sleep predict changes in inflammatory resolution mediators.

Methods: The randomized controlled within-subjects trial (N=24, 20-42 years, 12 women) consisted of two 19-day in-hospital protocols (experimental sleep disturbance/control). After three nights of baseline sleep (8h/night), participants in the experimental sleep disturbance condition were exposed to three cycles of three nights of disturbed sleep (delayed sleep-onset, hourly sleep disruption, advanced

sleep-offset) followed by one night of 8h-recovery sleep. The protocol ended with three nights of recovery sleep. In the control condition, participants had uninterrupted sleep (8h/night). Sleep (PSG) and resolvin lipid mediators in plasma (1100h, LC-MS/MS) were assessed at baseline, during the last cycle of sleep disturbance, and during/after the first and third night of final recovery sleep. Data were analyzed using generalized linear mixed models and Pearson/Spearman correlations.
Results: As expected, SWS amount decreased during experimental sleep disturbance and increased during the first recovery sleep night ($p<.001$). Similarly, resolvin (Rv) D2 and RvD3 decreased during sleep disturbance and RvD2 increased with subsequent recovery sleep ($p<.001$). The SWS response did not correlate with the resolvin response to sleep disturbance or to recovery sleep. However, the NREM sleep response correlated with the resolvin response during the third recovery sleep night, i.e., a greater NREM response was associated with a greater RvD2 and RvD3 response ($r=.68$, $p=.002$; $r=.58$, $p=.012$). In contrast, a greater REM sleep response was associated with a lower resolvin response ($r=-.63$, $p=.005$; $r=-.66$, $p=.003$).
Conclusion: These data suggest that during recovery from sleep disturbance, NREM rather than REM sleep promotes inflammatory resolution, thereby acting as the sleep state that protects against low-grade systemic inflammation, which has been frequently observed as a consequence of sleep disturbances. Analysis whether SWA is related to inflammatory resolution is in progress.
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INDIVIDUAL DIFFERENCES IN SKIN TEMPERATURE RESPONSES TO COLD PRESSOR STRESS DURING SLEEP RESTRICTION AND CIRCADIAN MISALIGNMENT

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Introduction: Individual differences in cognition during sleep restriction and circadian misalignment have been shown to be trait-like. Here we explored the consistency of individual differences in cardiovascular responses to the cold pressor test (CPT) measured by changes in the distal-proximal skin temperature gradient (DPG) using the contralateral hand to that immersed in the ice water bath, which reflects a reflex cutaneous vasoconstriction.
Methods: Eighteen healthy participants (8 females) mean (±SD) age 25.28 (±4.3), underwent two identical in-laboratory combined sleep restriction and circadian misalignment protocols preceded by an 8h baseline in-laboratory sleep opportunity. The participants were given a 3h sleep opportunity on night 2 and a 3h sleep opportunity on days 3 and 4 followed by recovery sleep. The CPT occurred the morning after the baseline sleep opportunity and the morning before recovery sleep. Participants maintained a seated posture beginning 30 min prior to the CPT and skin temperature was assessed starting 15 min before until 45 min after the CPT. DPG (proximal=subclavicular; distal=hand palmar) data were averaged into 3 min bins. Changes in DPG from pre-CPT and 5 min post-CPT were assessed as the primary outcome using mixed-model ANOVAs. Intra-class correlation coefficients (ICC) were calculated to measure consistency of individual differences for DPG responses.
Results: Mixed-model ANOVA revealed significant effects of time and combined sleep restriction and circadian misalignment on DPG during the CPT (both $p<0.05$), such that the DPG was wider (i.e., more negative) post-CPT and during sleep restriction and circadian misalignment. Participants showed moderately consistent DPG responses across visits 1 and 2 at baseline (ICC=0.59) and substantially consistent DPG responses during sleep restriction and circadian misalignment (ICC=0.67). Further, participants showed moderately consistent DPG responses when comparing changes between baseline and sleep restriction and circadian misalignment across visits (ICC=0.58).
Conclusion: Findings support that combined sleep restriction and circadian misalignment is associated with sympathetic activation and that individual differences in the DPG response to cold pressor stress are consistent.
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SLEEP QUALITY AS A PATHWAY FROM STRESS TO COLD SYMPTOM SEVERITY

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Introduction: Stress is a known contributor to immune system suppression associated with higher illness susceptibility, including acute infectious respiratory illness, or the common cold. Sleep quality, shown to impact immunity, is an additional mechanism that may underlie the association between stress and cold symptomatology. Although the associations between stress and sleep and cold symptomatology have been examined separately, little is known about the mechanistic role of sleep in these associations. The present study examined sleep quality as a potential pathway between stress and cold symptomatology difference scores.
Methods: Archival data from the Common Cold Project (Pittsburgh Cold Study 3) were utilized for the present study. Participants were 213 adults (Mean Age=30.1 yrs., SD=10.9 yrs., 42.3% female) who completed a 5-day viral challenge and self-report measures of cold severity (Jackson Symptom Score; measured from beginning to end of viral challenge), baseline sleep quality (PSQI), and perceived stress as part of study participation. SPSS v 27 and Hayes' PROCESS mediation macro were used to assess study aims. Age and sex were included as covariates.
Results: Greater perceived stress was significantly associated with worse sleep quality [B=.15, 95% CI .10, .21]. Sleep quality fully mediated the association between stress and changes in symptomatology; better sleep was associated with larger changes in cold severity [B=-.23, 95% CI -.43, -.04], defined as differences in symptomatology from

beginning to end of the viral challenge, beyond stress alone. Zero-order correlation analyses revealed a trend level (r=.04, p=.06) association between sleep quality and aggregate cold severity, suggesting that as sleep improves, symptoms decrease.
Conclusion: Within the present sample, sleep quality surfaced as an indirect pathway linking stress to changes in cold severity. Better sleep was associated with greater changes in cold severity above perceived stress. These findings, together with the trend level, positive association between sleep quality and cold symptomatology, suggest that better sleep may be associated with less severe symptomatology. Future research should attend to mechanisms underlying the associations between stress, sleep, and cold symptomatology.
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IMPACT OF EXPERIMENTALLY SHORTENED SLEEP ON MEAL TIMING IN ADOLESCENTS

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Introduction: Short sleep increases the risk for obesity in adolescents. One potential mechanism relates to when eating occurs, rather than what or how much is eaten. This study investigated the impact of shortened sleep on meal timing and late evening eating in adolescents.
Methods: 93 healthy 14- to17-year-olds (62% female) completed a within-subject counterbalanced experimental sleep manipulation, engaging in shortened sleep (SS; 6.5 hours/night in bed) or healthy sleep (HS; 9.5 hours/night in bed), each for five nights, with order randomized. Sleep timing was verified through wrist-worn actigraphy. During each sleep period, adolescents completed 2-3 dietary recalls. Repeated-measure T-tests assessed the sleep manipulation effect on averaged times of the first and last eating episode, number of eating episodes after 8:00pm, and range of the daily eating period.
Results: Youth averaged 2.2 hours/night longer sleep during HS than SS (p<.001). The timing of the first eating episode was similar across conditions, relative to the clock (SS=08:51, HS=08:52) and to time since waking (SS=1.8hr, HS=1.9hr). The timing of the last eating episode averaged later on the clock during SS (20:34) than HS (19:38; p<.001), resulting in a longer eating period (SS=11.7hr, HS=10.8hr, p<.001). Youth averaged more eating episodes after 8:00pm during SS (0.87) than HS (0.59, p<.001). The gap between last eating episode and sleep onset was larger in SS (4.1hr) than HS (2.8hr; p<.001). Notably, on average, adolescents last eating episodes during SS (20:34) were earlier than sleep onset in either condition, and were even 2 hours earlier than when they fell asleep during HS (M=22:30). In exploratory analyses, these effects did not systematically vary by experimental order of the sleep conditions, family income, or participant age, sex, or norm-referenced body mass index.
Conclusion: Shortened sleep resulted in adolescents eating later and lengthening the daily period of time in which they ate, despite typically stopping eating well before sleep onset during healthy sleep. Late evening eating and long daily eating periods have been strongly associated with weight gain, which may help explain the link between shortened sleep and increased obesity risk in adolescents.
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THE EFFECTS OF CHRONIC SLEEP RESTRICTION ON HUMAN OCULOMOTOR BEHAVIOR

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Introduction: Oculomotor behavioral metrics change according to time awake and circadian phase following a distinct pattern of impairment. Acute sleep deprivation (ASD) causes large decreases in pursuit initiation and steady-state gain, and a compensatory increase in saccadic rate without any systematic change in saccadic size. It also causes large deficits in visual processing of direction and speed, and impaired saccade dynamics. Such deterioration likely reflects changes in both higher cortical and brainstem function, explaining in-part how sleep loss and circadian misalignment affect cognition. It is unclear how oculomotor behavior might change according to chronic sleep restriction (CSR). Here, we measured the same eye-movement metrics during CSR.
Methods: Twelve healthy participants (6 females) kept a fixed wake-time sleep-wake schedule, at home for four weeks (weeks 1 and 3 = 9h time in bed (TIB); weeks 2 and 4 randomized to 5h or 9h TIB; actigraphy confirmed). Following weeks two and four, participants completed a 13-hour laboratory visit under dim light (<15 lux), where they maintained a semi-recumbent posture and were provided with hourly isocaloric snacks. A visual tracking task was performed hourly to assess pursuit and saccadic responses and visual motion processing. Performance metrics were computed using MATLAB, including pursuit gain (eye speed/target speed), the rate and amplitude of catch-up saccades, and the accuracy and precision of direction and speed processing.
Results: As expected, we found a small but significant (t(11)=-2.17, p<0.03) reduction in pursuit gain (mean+/-SEM: -0.028 +/-0.013 with a large (t(11)=2.96, p<0.01) increase in saccadic rate (0.37 +/-0.13 Hz). However, surprisingly, we found a significant (t(11)=-2.52, p<0.03) decrease in the amplitude of catch-up saccades (-0.15 +/-0.06 deg). The only systematic alteration to visual motion processing was a small reduction in horizontal-vertical asymmetry, which was previously observed with ASD.
Conclusion: A week of CSR to 5h is associated with only mild impairment in smooth pursuit eye movements with little impact on visual motion processing. However, CSR caused a maladaptive decrease in saccade amplitude that was not observed during ASD. Eye-movement metrics reveal differential neurological effects of CSR versus ASD.
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ACUTE EFFECTS OF METHADONE, BUPRENORPHINE OR NALTREXONE ON SLEEP-LIKE PARAMETERS EVALUATED WITH ACTIGRAPHY IN MALE RHESUS MONKEYS

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Introduction: Opioid use disorder (OUD) is a significant public health problem, and it has been associated with the emergence of sleep disturbances. Effective treatment options for OUD exist, including medication-assisted therapy with methadone or buprenorphine. However, emerging evidence suggests that these treatments also may be associated with significant sleep impairment. The extent to which these effects are a result of the medication or an effect of chronic opioid use remains unknown. In the present study, we investigated the acute effects of methadone, buprenorphine or naltrexone in male rhesus monkeys in order to understand whether pharmacological treatment with these drugs per se would have deleterious effects on sleep.

Methods: Adult naïve male rhesus macaques (Macaca mulatta, n=5) maintained on a 12h/12h light/dark cycle were fitted with primate collars to which actigraphy monitors were attached. Actigraphy recording was conducted during baseline conditions and following acute injections of vehicle, methadone (0.03 – 1.0 mg/kg, i.m.), buprenorphine (0.01 – 1.0 mg/kg, i.m.) or naltrexone (0.03 – 1.0 mg/kg, i.m.) in the morning (10h, 4h after "lights on") or in the evening (16:30h, 1.5h before "lights off").
Results: Morning treatment with methadone or buprenorphine dose-dependently impaired sleep in rhesus monkeys, with at least one dose significantly increasing sleep latency and decreasing sleep efficiency. Evening treatment with methadone or buprenorphine also impaired sleep, with lower doses significantly inducing sleep alterations compared to morning treatments. The effects of buprenorphine on sleep was a biphasic function, with the highest doses not disrupting sleep. Treatment with naltrexone significantly improved sleep-like measures in rhesus monkeys, with evening treatments improving measures of both sleep latency and sleep efficiency.
Conclusion: Acute administration of methadone and buprenorphine induced marked sleep impairment in rhesus monkeys, even when the drugs were administered in the morning. Unexpectedly, acute administration of the opioid antagonist naltrexone significantly improved sleep-like measures. Our findings show that the currently available pharmacotherapies for OUD significantly affect sleep in naïve monkeys, and that opioid mechanisms yet to be determined may play a significant role in sleep-wake regulation.
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ONE NIGHT OF MILD SLEEP RESTRICTION AFFECTS EEG AND BEHAVIOURAL MEASURES OF VIGILANCE

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Introduction: Much is known about the behavioural and cognitive consequences of chronic sleep loss but relatively little is known about the changes in brain activity associated with reduced vigilance after mild and acute sleep loss. Mild and acute sleep loss is generally thought to be innocuous despite research showing emotional processing, visual attention and behavioural responding are all negatively impacted by even small amounts of sleep loss. The current study investigated behavioural, cognitive, and electrophysiological consequences of mild (i.e., a couple of hours) and acute (i.e., a single night) sleep loss via simultaneous behavioural and physiological measures of vigilance.
Methods: Participants (N = 23; 18 females, Mage = 22 ± 3 years) came into the lab (from ~12 pm to 3 pm) for two testing days after sleeping from 1 am to 6 am (Sleep Restriction), or from 12 am to 9 am (Normally Rested). Brain activity was recorded using electroencephalography (EEG) from 15 scalp derivations, while vigilance was assessed simultaneously using the psychomotor vigilance task (PVT).
Results: Vigilance was reduced in the Sleep Restricted vs. Normally Rested condition, ($F(1,22)=9.02$, $p=0.007$). This was exacerbated over the course of performing the PVT, ($F(5,110)=8.12$, $p<0.001$). Sleep Restriction also resulted in increased intensity of alpha burst activity compared to the Normally Rested condition ($F(1,20)=6.19$, $p=0.022$). Lastly, EEG spectral power differed between restriction sleep conditions across deepening stages of sleep onset, particularly for frequencies that reflect arousal e.g., delta, alpha and beta activity ($F(1,20)>5.52$, $p<0.029$).
Conclusion: These results suggest that even a small amount of sleep loss, occurring on only one night significantly reduces vigilance and impacts the physiology of the brain in ways that reflect reduced arousal. Understanding the neural correlates and cognitive processes associated with sleep loss may lead to important advancements in identifying and preventing potentially deleterious or dangerous, sleep-related lapses in vigilance (e.g., in the classroom, workplace), and when lapses in vigilance can be life-threatening (e.g., while driving).
Support (if any):

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SLEEP AND PORPHYROMONAS GINGIVALIS K-CAPSULAR IGG SEROTYPES: A STUDY IN THE OLD ORDER AMISH

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Introduction: Sleep problems and periodontal disease have a bidirectional relationship and are independently linked with depression, dementia, and metabolic disease. Inadequate sleep can worsen inflammation, a hallmark of periodontal disease, and the activation of the immune system can alter sleep/wake cycles. A key player in periodontal disease is Porphyromonas gingivalis, a bacteria that can translocate to the brain and induce miRNA's. Antibodies to P. gingivalis capsular virulence factors, K1-7, have been used to estimate P. gingivalis virulence. This study was conducted to explore cross-sectional associations between seropositivity of K serotypes of P. gingivalis and measures of self-reported impairment in sleep. If identified, these links would provide a rationale to initiate causality and mediation studies. We hypothesized that sleep impairment is positively associated with P. gingivalis K IgG serointensity.
Methods: 880 Old Order Amish aged 44.8 (SD: 17.2 years); 360 men (40.91%), 520 women (59.09%) responded to an adapted Pittsburgh-Sleep-Quality-Index questionnaire. IgG serointensity to 7 K-capsular P. gingivalis serotypes were measured with ELISAs. We tested for the association of log-transformed serotype IgG intensity and positivity (successively defined as within the top 5% and 25% for each serotype) with sleep parameters (as binary and continuous variables) using linear and logistic regressions, adjusting for age and sex.
Results: We confirmed no hypothesized associations between any of the sleep problems on the PSQI and K serotype serointensity and seropositivity. Exploratory analysis returned a negative association of log-transformed K3 IgG with daytime sleepiness ($p=0.01$); however, this did not resist adjustment for multiple comparisons and was inconsistent with the direction of the hypothesis.
Conclusion: Strengths of the study include the reduced smoking prevalence in the Amish and the relatively homogenous lifestyle, reducing confounding. The results imply P. gingivalis serotypes are not associated with sleep disturbance. Limitations are self-reporting of sleep, cross-sectional approach and limited generalizability. Results

do not support an association between P. gingivalis K serotypes and sleep-problems.
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RECOVERY DYNAMICS IN A BIOMATHEMATICAL MODEL OF FATIGUE

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Introduction: In commercial aviation and other operational settings where biomathematical models of fatigue are used for fatigue risk management, accurate prediction of recovery during rest periods following duty periods with sleep loss and/or circadian misalignment is critical. The recuperative potential of recovery sleep is influenced by a variety of factors, including long-term, allostatic effects of prior sleep/wake history. For example, recovery tends to be slower after sustained sleep restriction versus acute total sleep deprivation. Capturing such dynamics has proven to be challenging.
Methods: Here we focus on the dynamic biomathematical model of McCauley et al. (2013). In addition to a circadian process, this model features differential equations for sleep/wake regulation including a short-term sleep homeostatic process capturing change in the order of hours/days and a long-term allostatic process capturing change in the order of days/weeks. The allostatic process modulates the dynamics of the homeostatic process by shifting its equilibrium setpoint, which addresses recently observed phenomena such as reduced vulnerability to sleep loss after banking sleep. It also differentiates the build-up and recovery rates of fatigue under conditions of chronic sleep restriction versus acute total sleep deprivation; nonetheless, it does not accurately predict the disproportionately rapid recovery seen after total sleep deprivation. To improve the model, we hypothesized that the homeostatic process may also modulate the allostatic process, with the magnitude of this effect scaling as a function of time awake.
Results: To test our hypothesis, we added a parameter to the model to capture modulation by the homeostatic process of the allostatic process build-up during wakefulness and dissipation during sleep. Parameter estimation using previously published laboratory datasets of fatigue showed this parameter as significantly different from zero ($p<0.05$) and yielding a 10%–20% improvement in goodness-of-fit for recovery without adversely affecting goodness-of-fit for pre-recovery days.
Conclusion: Inclusion of a modulation effect of the allostatic process by the homeostatic process improved prediction accuracy in a variety of sleep loss and circadian misalignment scenarios. In addition to operational relevance for duty/rest scheduling, this finding has implications for understanding mechanisms underlying the homeostatic and allostatic processes of sleep/wake regulation.
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SHORT SLEEP AND INSOMNIA AS INDEPENDENT PREDICTORS OF OBESITY, HYPERTENSION, AND DIABETES

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Introduction: Epidemiological evidence of short sleep's (<6 hours) association with negative cardiometabolic health outcomes continues to mount; yet, the complex relationship between sleep and health is still not well-understood. Sleep problems, such as short sleep and insomnia, are often analyzed as a singular construct at the population level; however, it has been proposed that, although these two sleep problems likely overlap, they are separate phenomena. The purpose of this study was to: (1) determine if short sleep and insomnia were independent constructs; and to (2) evaluate whether short sleep and insomnia predicted obesity, hypertension, and diabetes.
Methods: Analyses were based on the 2015-2016 National Health and Nutrition Examination Survey (NHANES). NHANES employs a complex, multistage, probability sampling design to survey a representative sample of non-institutionalized U.S. adults (≥18 years). Data related to short (<6), normal (7-8), and long (9+) sleep duration, insomnia (present: mild, moderate, severe), hypertension (present: previous hypertension/hypertension medications/blood pressure in the hypertensive range), and diabetes (present: history of diabetes/fasting blood sugar of 130+) were extracted for analysis. Age, sex, and obesity (body mass index, 30.0+) were entered as covariates into the models.
Results: Among the subjects, 0.08% were normal sleepers with insomnia; 0.21% were short sleep with insomnia; and, 0.59% had insomnia with short sleep. Short sleep without insomnia (OR=1.35; $p<.001$), normal sleep with insomnia (OR=1.56; $p<.001$), and short sleep with insomnia (OR=1.64; $p<.001$) uniquely predicted obesity. As well, short sleep without insomnia (OR=1.23; $p=0.004$) as well as short sleep with insomnia (OR=1.21; $p<0.001$) independently predicted hypertension. Furthermore, short sleep with (2.01; $p<0.001$) and without (OR=1.48; $p<0.001$) insomnia as well as normal sleep with insomnia ($p=0.007$) uniquely predicted diabetes.
Conclusion: Findings from this study suggested short sleep and insomnia are independent constructs, uniquely predicting obesity, hypertension, and diabetes. Short sleep and insomnia neither mediated nor moderated one another, implying these two sleep outcomes are not additive in nature, but are instead separate health problems. The distinction between short sleep and insomnia may have important epidemiological and clinical implications.
Support (if any): N/A

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DOES EXTRAVERSION PREDICT SUBJECTIVE RATINGS OF SLEEPINESS AND PERFORMANCE DURING SLEEP DEPRIVATION?

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Introduction: Repeated exposure to total sleep deprivation (TSD) within individuals has demonstrated task-specific, trait-like individual differences in cognitive impairment and subjective sleepiness. Research has suggested that introversion/extraversion may predict individual vulnerability to TSD. While previous analyses have found that extraversion does not reliably predict objective performance impairment on the psychomotor vigilance test (PVT) during TSD, it is not known whether extraversion may predict individuals' subjective responses to TSD, including subjective ratings of sleepiness, fatigue, mood, performance, and effort.
Methods: N=21 healthy adults (aged 21-38; 9 women) completed three 4-day/3-night laboratory sessions – each including a baseline night, 36h TSD period, and recovery night –separated by at least 2 weeks each. Two of the sessions were preceded by a week of sleep extension (12h nightly sleep opportunities), while one session was preceded by a week of sleep restriction (6h nightly sleep opportunities), in randomized, counterbalanced order; only the sleep extension sessions are used here. Prior to the experiment, subjects filled out the Eysenck Personality Questionnaire (EPQ), which yielded an extraversion score; one subject did not complete the questionnaire and was

excluded from analyses. Every 2h during TSD, subjects completed a 60min neurobehavioral test battery. At the beginning of the test battery, subjects completed the Karolinksa Sleepiness Scale (KSS) and visual analog scales of mood and fatigue (VAS-M and VAS-F). At the end of the test battery, subjects completed self-ratings of their performance (1–7 scale) and effort (1–4 scale). The relationship between extraversion and subjective scores after sleep deprivation (average over last 24h of 36h TSD period) relative to baseline (average over first 12h of TSD period) was analyzed using mixed-effects analysis of covariance, controlling for order, with a random effect over subjects on the intercept.

Results: No significant relationships were observed between extraversion and subjective estimates of sleepiness (KSS, p=0.45), fatigue (VAS-F, p=0.80), mood (VAS-M, p=0.14), performance (p=0.89), and effort (p=0.93).

Conclusion: These results indicate that extraversion is not a reliable predictor of trait-like individual differences in subjective vulnerability to 36h TSD.

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SHORT AND LONG SLEEP DURATION, POOR SLEEP QUALITY, AND LATER SLEEP ARE ASSOCIATED WITH LOWER ODDS OF ADOLESCENTS EATING BREAKFAST

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Introduction: Sleep health is linked to dietary choices, and skipping breakfast is associated with risk of negative health outcomes in adolescents. However, there is a lack of research on whether dimensions of sleep at night predict adolescents eating breakfast the next day. We investigated within- and between-person associations of multiple aspects of sleep with adolescent breakfast consumption.
Methods: Data were collected from a subset of the age 15 wave of the Fragile Families and Child Wellbeing Study (n=590). Teens wore an actigraphy device and completed daily surveys for ~1 week (mean=5.9 days). Surveys assessed subjective sleep quality (low–high) and consumption of breakfast (no/yes). Mixed models assessed whether actigraphy-measured sleep timing (onset, midpoint, and offset) and subjective sleep quality predicted odds of breakfast consumption in both within- and between-person models. A curvilinear association between sleep duration and breakfast consumption was also assessed. Irregularity of sleep duration and timing were tested as additional predictors, calculated as SD per person (in between-person models only). Analyses included random intercepts for participants and covariates: school day, boredom, loneliness, happiness, depressive symptoms, sex, race/ethnicity, body mass index, and household income.
Results: Within-person analyses revealed a significant curvilinear association between sleep duration and breakfast consumption, such that on nights when teens slept shorter or longer than their average, they had lower odds of eating breakfast the next day ($p=.005$). Additionally, on nights when teens had a later sleep midpoint or offset than their usual, they tended to skip breakfast the next day (both $p<.05$). Between-person models showed that teens who on average had later sleep timing (onset, midpoint, and offset) and who reported lower sleep quality had lower odds of eating breakfast (all $p<.04$). Lastly, teens with greater irregularity of sleep duration and sleep timing (midpoint and offset) had lower odds of eating breakfast (all $p<.009$).
Conclusion: Findings indicate that multiple dimensions of adolescent sleep health, including long and short sleep duration, later sleep timing, and poorer sleep quality, are associated with lower odds of eating breakfast. These sleep and dietary behaviors in adolescence may consequently impact future metabolic health.
Support (if any): R01HD073352

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SCREEN-BASED ACTIVITIES PREDICT DELAYED SLEEP TIMING WITHIN AND BETWEEN ADOLESCENTS

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Introduction: Daytime and evening screen use have been associated with poor sleep health among adolescents, especially delayed sleep timing. However, most studies only investigate associations between adolescents rather than within the same person across multiple nights. Our multilevel modeling approach allows for assessment of connection between screen use and subsequent sleep timing.
Methods: We analyzed approximately five days of data from the Fragile Families and Child Wellbeing Study, a longitudinal birth cohort (n=475 adolescents, 15.4±0.5 years old). Adolescents wore wrist actigraphy devices and completed daily surveys reporting how many hours across the day they engaged in screen-based activities (e.g., communicating with friends, playing video games) and whether they engaged in screen-based activities in the hour before bed. Screen use was separated into within- and between-person variables predicting sleep onset and midpoint that night. Multilevel models with random intercepts for each sleep outcome adjusted for school days, bedtime routines, adolescent demographics, and family socioeconomic status.
Results: Within-person results showed that on days when adolescents played video games more than their daily average±SE (79±3 min) sleep onset was delayed (5±2 min, $p<0.01$) and midpoint was delayed (4±2 min, $p<0.03$) for each additional hour. Between-person results showed that adolescents who played video games had delayed sleep onset (9±4 min, $p<0.02$) and midpoint (7±3 min, $p<0.04$) for each hour spent playing across the day. Adolescents who spent time using screens to communicate with friends had delayed sleep onset (11±3 min, $p<0.01$) and midpoint (9±3 min, $p<0.01$) for each hour across the day. Adolescents who were more likely to use screens to communicate with friends or play video games before bed had delayed sleep onset (29±13 min, $p<0.03$) and midpoint (24±12 min, $p<0.05$). Other screen-based activities such as watching videos were not associated with sleep timing.
Conclusion: Daytime and evening screen-based activities may not uniformly delay sleep. Adolescents who engage in social or interactive screen-based activities may delay sleep timing more than day-to-day variation alone. Future research should evaluate how attributes of screen-based socializing and interactivity affect sleep health.
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PRENATAL SLEEP QUALITY AND INFANT SLEEP: A LONGITUDINAL STUDY

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Introduction: Poor sleep quality is common during pregnancy and can increase the risk of adverse obstetric and fetal outcomes. Existing research on the association between prenatal sleep and infant sleep is scarce and has focused on other aspects of prenatal sleep such as sleep duration, chronotype, and insomnia symptoms. To our knowledge, no studies have examined the association between prenatal sleep quality and infant sleep outcomes. Thus, this study aimed to investigate whether maternal sleep quality during pregnancy was prospectively associated with infant sleep dimensions, independent of relevant covariates.
Methods: Participants were a subset of 272 mother-infant dyads enrolled in an ongoing cohort study. Maternal prenatal sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI) in early to mid- (M gestational age = 15.12 ± 3.56 weeks) and late- (M gestational age = 32.44 ± 0.99 weeks) pregnancy. Mothers completed the Brief Infant Sleep Questionnaire (BISQ) at 3, 6, and 12 months postpartum. The following infant sleep parameters were assessed: sleep duration (day, night, 24-hour), number of night awakenings, and wake after sleep onset. Prenatal depressive symptoms were assessed with the Edinburgh Postnatal Depression Scale (EPDS) at both pregnancy time points. Other covariates included maternal age at enrollment, infant age, parity, and co-sleeping status.

Results: Generalized estimating equations (GEE) models revealed that poorer maternal sleep quality during early-to-mid pregnancy did not significantly predict infant sleep parameters after adjustment for covariates ($p > .05$). However, in late pregnancy, poorer maternal sleep quality significantly predicted shorter 24-hour sleep duration and longer wake after sleep onset, but not daytime sleep duration, nighttime sleep duration, and number of night awakenings ($p < .05$).
Conclusion: Study findings advance our understanding of the prospective link between maternal prenatal sleep quality and infant sleep. Results indicate that maternal sleep quality during late gestation may play a role in the development of infant sleep patterns. These findings have important implications for intervention efforts targeting maternal sleep quality during pregnancy. Future research should use objective measures of sleep, such as actigraphy, to better elucidate the effects of prenatal sleep quality on infant sleep outcomes.
Support (if any): The Canadian Institutes of Health Research (CIHR)

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THE SHARED AND UNIQUE GENETIC INFLUENCES OF PUBERTAL DEVELOPMENT AND OBJECTIVE SLEEP DURING MIDDLE CHILDHOOD

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Introduction: More advanced pubertal development has negative impacts on sleep quality and quantity in adolescents (Foley et al., 2018). Pubertal development and sleep both have high genetic influences, while environmental factors are also evident (Breitenstein et al., 2020; Dick et al., 2001). To elucidate underlying relations between pubertal development and sleep, the present study examined the genetic and environmental influences on the covariation of these health processes using a twin study design.
Methods: This racially and socioeconomically diverse sample included 596 twin children (Mage=8.41, SD=.69; 51.7% female; 66.3% White; 33.7% Hispanic; 156 monozygotic, 217 same-sex dizygotic, and 179 opposite-sex dizygotic). Children wore wrist-based accelerometers (Motion Logger Micro Watch; Ambulatory Monitoring, Inc, Ardsley, NY USA) on their non-dominant wrist for 7 nights (M= 6.81, SD= .67) to measure their sleep (efficiency, duration). Primary caregivers completed Zygosity Questionnaire for Young Twins (Goldsmith, 1991), as well as the Pubertal Development Scale (Petersen et al., 1988) for each twin, and puberty composite scores for males and females were used (Coleman & Coleman, 2002). Bivariate Cholesky decompositions were fit in OpenMX to estimate genetic and environmental influences on the covariance between pubertal development and sleep (Boker et al., 2011). The -2 log-likelihood chi-square test of fit and the Akaike's Information Criterion were used to find the most parsimonious solution.
Results: 261 White (68.9%) and 135 Hispanic (77.1%) participants had initiated puberty. Pubertal development was positively correlated with sleep efficiency (r =.15) and sleep duration (r =.15). Pubertal development, sleep efficiency, and sleep duration were all heritable at 59%, 54%, and 73%, respectively. The AE-A-AE twin model was the best-fitting model for both bivariate models, with additive genetics accounting for 86% and 90% of the shared covariance between pubertal development and sleep efficiency and duration, respectively.
Conclusion: The genetic association between pubertal development and sleep suggests a third variable influence, and Wang and colleagues (2020) have identified genetic variants that partially explain the association. Future directions include longitudinal analyses across the pubertal transition as environmental demands increase.
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TEMPORAL AND BIDIRECTIONAL ASSOCIATIONS BETWEEN OBJECTIVELY MEASURED PHYSICAL ACTIVITY AND SLEEP IN PRESCHOOLERS

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Introduction: Physical activity (PA) and sleep contribute to overall health in early childhood. To explore the interactive relationships of these behaviors in older children and adults, previous studies have examined temporal between- and within-person associations through micro-longitudinal designs. However, such analyses have not been conducted in early childhood, when behaviors are guided by adult caregivers. The purpose of this analysis was to examine temporal and bidirectional associations between SED, PA, and sleep in preschool children.
Methods: Wake (activity counts/min and percent time in SED, light PA [LPA], and moderate-to-vigorous PA [MVPA]) and overnight sleep (sleep duration, sleep efficiency [SE], mid-sleep point [MSP]) were assessed via wrist-based actigraphy (mean = 10.4 days and 9.8 nights) and recorded as repeated (daily) measures. Multilevel models with lagged effects and AR(1) error covariance structure were used to examine the temporal associations between wake and sleep measures and adjusted for age, sex, socioeconomic status, and nap frequency.
Results: With PA measures as predictors, between-person associations were positive between activity counts and SE ($p=0.004$), SED and SE ($p=0.004$), LPA and sleep duration ($p=0.005$), and negative between LPA and MSP ($p=0.039$) and MVPA and SE ($p=0.003$). Within-person associations were positive between activity counts and sleep duration ($p=0.010$), activity counts and SE ($p=0.018$), MVPA and sleep duration ($p=0.003$), MVPA and SE ($p=0.004$), and negative between SED and SE ($p=0.034$) and LPA and sleep duration ($p=0.045$). With sleep measures as predictors, associations were positive between sleep duration and LPA ($p<0.001$) and SE and SED ($p=0.008$), and negative between MSP and LPA ($p=0.009$), SE and activity counts ($p=0.001$), and SE and MVPA ($p=0.003$). Within-person associations were positive between SE and activity counts ($p=0.001$) and SE and MVPA ($p=0.001$), and negative between sleep duration and LPA ($p=0.001$) and SE and SED ($p=0.012$).
Conclusion: Generally, days with higher levels of activity or sleep were not associated with greater subsequent sleep or PA. Conversely, when participants obtained greater PA or sleep compared to their individual average, some beneficial associations were evident. These findings demonstrate some evidence of temporal associations between PA and sleep, although the bidirectional nature was not conclusive.
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AEROBIC FITNESS IS ASSOCIATED WITH ADVANCED CIRCADIAN RHYTHMS IN ADOLESCENTS

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Introduction: Aerobic fitness facilitates brain synaptic plasticity, which influences global and local sleep expression. While it is known that sleep patterns/behavior and non-rapid eye movement (NREM) sleep slow wave activity (SWA) tracks brain maturation, little is known about how aerobic fitness and sleep interact during development in youth. The aim of this pilot was to characterize relationships among aerobic fitness, measures of global/local sleep expression, and habitual sleep patterns in children and adolescents. We hypothesized that greater aerobic fitness would be associated with better sleep quality, indicated by increased SWA.
Methods: 20 adolescents (mean age=14.6±2.3 years old, range 11-17, 11 females) were evaluated for AF (peak VO2 assessed by ramp-type progressive cycle ergometry in the laboratory), habitual sleep duration and efficiency (continuous 7-14 day actigraphy with sleep diary), and topographic patterns of spectral power in slow wave, theta, and sleep spindle frequency ranges in non-rapid eye movement (NREM) sleep using overnight polysomnography with high-density electroencephalography (hdEEG, 128 channels).
Results: Significant relationships were observed between peak VO2 and habitual bedtime (r=-0.604, p=0.013) and wake-up time (r=-0.644, p=0.007), with greater fitness associated with an earlier sleep schedule (going to bed and waking up earlier). Peak VO2 was a significant predictor of slow oscillations (0.5-1Hz, p=0.018) and theta activity (4.5-7.5Hz, p=0.002) over anterior frontal and central derivations (p<0.001 and p=0.001, respectively) after adjusting for sex and pubertal development stage. Similar associations were detected for fast sleep spindle activity (13-16Hz, p=0.006), which was greater over temporo-parietal derivations.
Conclusion: Greater AF was associated with earlier habitual sleep times and with enhanced expression of developmentally-relevant sleep oscillations during NREM sleep. These data suggest that AF may 1) minimize the behavioral sleep delay commonly seen during adolescence, and 2) impact topographically-specific features of sleep physiology known to mechanistically support neuroplasticity and cognitive processes which are dependent on prefrontal cortex and hippocampal function in adolescents and adults.
Support (if any): NCATS grant #UL1TR001414 & PERC Systems Biology Fund

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BETTER AEROBIC FITNESS IS ASSOCIATED WITH DISTINCT SLEEP CHARACTERISTICS IN ADOLESCENTS

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[1]University of California Irvine, [2]University of California, Irvine, [3]University of California, Irvine, School of Medicine

Introduction: Aerobic fitness facilitates brain synaptic plasticity, which influences global and local sleep expression. While it is known that sleep patterns/behavior and non-rapid eye movement (NREM) sleep slow wave activity (SWA) tracks brain maturation, little is known about how aerobic fitness and sleep interact during development in youth. The aim of this pilot was to characterize relationships among aerobic fitness, measures of global/local sleep expression, and habitual sleep patterns in children and adolescents. We hypothesized that greater aerobic fitness would be associated with better sleep quality, indicated by increased SWA.
Methods: 20 adolescents (mean age=14.6±2.3 years old, range 11-17, 11 females) were evaluated for AF (peak VO2 assessed by ramp-type progressive cycle ergometry in the laboratory), habitual sleep duration and efficiency (continuous 7-14 day actigraphy with sleep diary), and topographic patterns of spectral power in slow wave, theta, and sleep spindle frequency ranges in non-rapid eye movement (NREM) sleep using overnight polysomnography with high-density electroencephalography (hdEEG, 128 channels).
Results: Significant relationships were observed between peak VO2 and habitual bedtime (r=-0.604, p=0.013) and wake-up time (r=-0.644, p=0.007), with greater fitness associated with an earlier sleep schedule (going to bed and waking up earlier). Peak VO2 was a significant predictor of slow oscillations (0.5-1Hz, p=0.018) and theta activity (4.5-7.5Hz, p=0.002) over anterior frontal and central derivations (p<0.001 and p=0.001, respectively) after adjusting for sex and pubertal development stage. Similar associations were detected for fast sleep spindle activity (13-16Hz, p=0.006), which was greater over temporo-parietal derivations.
Conclusion: Greater AF was associated with earlier habitual sleep times and with enhanced expression of developmentally-relevant sleep oscillations during NREM sleep. These data suggest that AF may 1) minimize the behavioral sleep delay commonly seen during adolescence, and 2) impact topographically-specific features of sleep physiology known to mechanistically support neuroplasticity and cognitive processes which are dependent on prefrontal cortex and hippocampal function in adolescents and adults.
Support (if any): NCATS grant #UL1TR001414 & PERC Systems Biology Fund

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WITHIN-FAMILY DYNAMICS INFLUENCING PARENT AND CHILD SLEEP QUALITY AND NIGHTTIME ACTIVITIES

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Introduction: Increasing efforts have focused on child sleep due to its benefits to academics and physical/mental health. Less understood are the within-family dynamics that drive sleep-related behavior.
Methods: Data were obtained from the 2014 National Sleep Foundation Sleep in America Poll (N=1102 parent/child dyads). Variables including age, gender, sleep quality (Excellent/Good/Fair/Poor), evening activities including reading, TV-watching, and online browsing/gaming (Never/Rarely/Sometimes/Often) were reported for parent and child. Ordinal logistic regressions examined child nighttime activity as outcome and nighttime activities (entered simultaneously in the model, adjusted for each other) as independent variables, adjusted for parent and child age, sex, and sleep quality.
Results: Worse sleep quality in parents was associated with worse sleep quality in their children. Moreover, increased likelihood of child television-watching at night was not associated with parental sleep quality, but it was associated with child sleep quality, with "Fair" and "Poor" sleepers more likely to watch TV (Fair: oOR=1.7,p=0.018; Poor: oOR=8.0,p=0.001). Child television-watching was not associated with likelihood of parental reading, but it was associated with likelihood of parental online browsing/gaming (Rarely oOR=1.7,p=0.001; Sometimes oOR=2.3,p<0.0005; Often oOR=1.9,p=0.004) and parental TV-watching (Rarely oOR=2.6,p<0.0005; Sometimes oOR=5.4,p<0.0005; Often oOR=13.3,p<0.0005). Child online browsing/gaming was also not associated with parental sleep quality but it was associated with child sleep quality (Fair oOR=2.3,p=0.001; Poor oOR=4.8,p=0.009) and parental reading (Rarely oOR=1.5,p=0.04; Often oOR=1.6,p=0.03), TV-watching (Rarely oOR=2.3,p=0.004; Sometimes oOR=2.8,p<0.0005; Often oOR=4.6,p<0.0005) and online browsing/gaming (Rarely oOR=2.8,p<0.0005; Sometimes

oOR=5.0,p<0.0005; Often oOR=7.8,p<0.0005). Child reading was not associated with parent or child sleep quality or parental online browsing/gaming, but it was related to parental TV-watching (Sometimes oOR=1.45,p=0.04; Often oOR=1.6,p=0.02) and reading (Rarely oOR=2.4,p<0.0005; Sometimes oOR=4.4,p<0.0005; Often oOR=6.9,p<0.0005).
Conclusion: Children who do not sleep well have parents who do not sleep well. Further, parents who read are more likely to have children who read, and parents on screens are more likely to have children on screens. Interventions targeted to parents may lead to better sleep habits in children.
Support (if any):

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SLEEP THIEF! FALLING ASLEEP WITH THE TV ON IS RELATED TO SHORTER SLEEP DURATION AMONG LATINO/A CHILDREN

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Introduction: Sleep duration is associated with obesity in Latino/a children. However, little is known about Latino/a children's bedtime behaviors who have a higher prevalence of obesity compared to white children. An improved understanding of Latino/a children's bedtime behaviors is warranted to inform health promotion programs in this population. The purpose of this study was to examine bedtime activities and behaviors with sleep characteristics of Latino/a children.
Methods: Children of Mexican descent (8-10 years old) and their mothers (N=32) from the San Francisco Bay Area were invited to participate in a 3-week crossover study. Mothers completed a questionnaire on sleep behaviors (e.g., duration, disturbances) and activities 1 hour before bed (e.g., television viewing in bed, eating or drinking). Mother and child anthropometrics were measured. Preliminary bivariate analyses included: (1) a linear regression examining child weekday sleep duration (dependent) with child behavior before bed (independent), and (2) a logistic regression examining child sleep disturbances (dependent) with child behavior before bed (independent).
Results: The average child age was 9.71 (SD = 0.96); almost half of children were obese (47%) and their mothers (53%). Children slept on average 10.07 (SD= 2.36) hours on weekdays and 10.31 on weekends (SD = 2.21); 26% of children experienced difficulty falling asleep ≥ 1per week, 52% watched television in the hour before bed, and 21% watched television to fall asleep ≥ 1 per week. Mothers slept on average 6.07 (SD = 1.57) on weekends and 6.99 (SD =5.75) on weekdays. In the hour before bed, children consumed/drank cereal and/or waffles (59%), drank plain milk (38%), drank flavored milk (19%), and juice (16%). Watching television to fall asleep was associated with shorter sleep duration (B = -0.45, P = 0.03), with a trend toward significance with increased odds of difficulty falling asleep (OR = 5.0, P = 0.09).
Conclusion: Watching television to fall asleep may be a risk factor for shorter sleep duration and difficulty falling asleep. A larger study to examine sleep related factors, such as unhealthy practices before bed, is warranted to understand the high obesity prevalence among Latino/a children.
Support (if any): K01HL129087 (PI: Martinez)

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PERCEIVED SLEEP NEED, CUMULATIVE SLEEP DEFICIT, AND ASSOCIATIONS WITH DAILY AFFECT IN ADOLESCENTS: 28 DAYS OVER SCHOOL & VACATION

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Introduction: This study aimed to describe trajectories of daily perceived sleep need and sleep deficit across 28 consecutive days, and examine if cumulative sleep deficit predicts next-day affect.
Methods: Daily sleep and affect were measured over 2 weeks of school and 2 weeks of vacation in 205 adolescents (54.1% females, Mage = 16.9 years). Each day, participants completed actigraphy and self-reported the amount of sleep needed to function well the next day (i.e., perceived sleep need), sleep duration, and high- and low-arousal positive and negative affect. Cumulative actigraphy and diary sleep deficit were calculated as difference between perceived sleep need and sleep duration, weighted by sleep deficit over the past 3 days. Cross-lagged, multilevel models were used to test cumulative sleep deficit as a predictor of next-day affect. Lagged affect, day of the week, study day, and sociodemographics were controlled.
Results: Perceived sleep need was lower early in the school week, before increasing in the second half of the week. Adolescents accumulated sleep deficit across school days and reduced it during weekends. During weekends and vacations, adolescents' self-reported, but not actigraphy sleep duration, met perceived sleep need. Higher cumulative actigraphy sleep deficit predicted higher next-day high arousal negative affect; higher cumulative diary sleep deficit predicted higher negative affect (regardless of arousal), and lower low arousal positive affect the following day.
Conclusion: Adolescents experienced sustained cumulative sleep deficit across school days, and whilst non-school nights appeared to be opportunities for reducing sleep deficit. Trajectories of sleep deficit during vacation suggested recovery from school-related sleep restriction. Cumulative sleep deficit was related to affect on a daily basis, highlighting the value of this measure for future research and interventions.
Support (if any):

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IMPACT OF BEHAVIORAL DISORDERS AND THEIR PHARMACOLOGICAL TREATMENT ON THE MATURATIONAL TRAJECTORIES OF NREM SLOW WAVE ACTIVITY

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Introduction: Slow wave activity (SWA) in the delta (0.4-4 Hz) frequency range declines in typically developing (TD) children as they transition to adolescence. However, it remains unknown whether the maturational trajectory of NREM delta power differs between TD youth and those with psychiatric/behavioral disorders.
Methods: We analyzed the sleep EEG of 664 subjects aged 6 to 21 (46.8% female, 24.7% racial/ethnic minority) from the Penn State Child Cohort, of whom 449 were TD, 123 were un-medicated and diagnosed with psychiatric/behavioral disorders, and 92 were medicated with stimulants, anti-depressants, anxiolytics, sedatives and/or anti-psychotics. Multivariable regression models adjusting for sex, race/ethnicity, BMI, AHI and PSG system tested the age-related trajectories of NREM delta power within each diagnostic group.
Results: Delta power in TD and un-medicated youth showed cubic age-related trajectories (both p-cubic<0.05). In TD youth, delta power was highest at age 6.6 and lowest at age 19.9, while in un-medicated youth it was highest at age 8.9 and lowest at age 18.6. The decreasing slope in delta power was 39.7% steeper in un-medicated youth (-22422 ± 5891/year, p<0.01) than TD youth (-16047 ± 2605/year, p<0.01). Delta power in medicated youth showed a distinct linearly

decreasing trajectory (-13518 ± 4597/year, p-linear<0.01) from age 6 (highest) to age 21 (lowest).
Conclusion: TD and un-medicated youth with psychiatric/behavioral disorders show SWA trajectories typical of brain maturation biomarkers (e.g., gray matter volume), characterized by a decreasing slope at the onset of puberty that reaches its nadir by late adolescence. However, SWA in un-medicated youth peaks two years later and reaches its nadir a year earlier than in TD youth. Thus, while TD children experience a smooth decline in SWA in the transition to adolescence, those with psychiatric/behavioral disorders experience a faster steep decline. In contrast, SWA in medicated youth appears to be dampened in early childhood and its slope linearly decreases with age. These data suggest that these youth may have a more severe disorder requiring pharmacological treatment, that the latter produces greater cortical arousability reflected in lower SWA power, and/or that psychoactive medications directly impact normal neurodevelopmental processes (e.g., synaptic pruning).
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SEX DIFFERENCES IN THE MATURATIONAL TRAJECTORIES OF SLEEP SPINDLES IN THE TRANSITION FROM CHILDHOOD TO ADOLESCENCE

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Introduction: Sleep spindles occur as bursts of EEG activity in the sigma (11-16 Hz) frequency range and are purported biomarkers of cortical development. However, the few studies examining maturational changes in sleep spindles are limited by small samples and/or short follow-up periods. Thus, large longitudinal population-based studies are needed to determine their developmental trajectories as the child transitions to adolescence.
Methods: We analyzed the sleep EEG of 572 un-medicated subjects aged 6-21 (47.6% female, 25.9% racial/ethnic minority), of whom 332 were 5-12 years at baseline and followed-up at ages 12-22. Multivariable-adjusted models tested the cross-sectional and longitudinal trajectories of sleep spindle density, frequency, and power.
Results: From age 6 to 21, the trajectory of sleep spindle density was best fit by a quadratic model (p=0.02), particularly in males (p-quadratic=0.05). Females maintained more stable levels of sleep spindle density (p-linear=0.26), as shown by a longitudinal increase 37.6% lower than males by age 14 (p=0.01). Sleep spindle frequency increased (p-linear<0.01), while sleep spindle power decreased (p-linear<0.01), from age 6 to 21. The trajectory of sleep spindle frequency diverged between females (p-linear<0.01) and males (p-quadratic=0.02), in whom it plateaued by age 15 onwards. Females had experienced a longitudinal increase in sleep spindle frequency 2.4% higher than males by age 20-22 (p=0.05). Males had experienced a steeper decreasing slope in sleep spindle power (p-linear<0.01) than females (p-linear=0.12), as confirmed by a longitudinal decline 25.4% greater than females by age 19 (p=0.02).
Conclusion: Sleep spindle metrics follow distinct maturational trajectories from each other and from other EEG oscillations (e.g., slow wave activity). The increase in sleep spindle density from childhood to early adolescence coupled with the linear increase in sleep spindle frequency from childhood to young adulthood may represent the emergence of fast sleep spindles, which appears to occur earlier in females. Overall, males experience greater maturational changes in all sleep spindle metrics and sex differences become prominent in young adulthood, when males show lower sleep spindle density and sleep spindle frequency, indicative of less fast sleep spindles.
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PROSPECTIVE ASSOCIATIONS BETWEEN PRE-SLEEP ELECTRONICS USE AND SAME-NIGHT SLEEP IN HEALTHY SCHOOL-AGED CHILDREN

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Introduction: Electronic media devices are ubiquitous in modern society and believed to adversely affect nighttime sleep. Cross-sectional research provides evidence of robust associations but prospective findings are limited and mixed. In this study, we examined the impact of specific types of electronics devices and overall use on objective and subjective sleep parameters the same night across one week.
Methods: The sample consisted of school-aged children (N=55) between the ages of 7 to 11 years. Hierarchical linear modeling was used to assess the impact of pre-bedtime electronics use on sleep the same night across 5 weekday nights. A sleep diary was used to record pre-bed electronic devices used and subjective sleep parameters. Objective sleep variables were assessed concurrently via actigraphy.
Results: The usage of different types of electronic media varied significantly between and within children across the five days. However, neither total electronics usage nor any individual type of device was found to significantly predict self-reported or objective sleep parameters the same night.
Conclusion: The extent to which the use of electronic media specifically within an hour of bedtime impacts sleep in school-aged children remains unclear. Future research should investigate these relationships using more robust methodology, including prospective designs and examination of relevant contextual and environmental factors.
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EARLY POSITIVE PARENT-CHILD INTERACTIONS AND ENRICHED HOME ENVIRONMENT ARE ASSOCIATED WITH BETTER INFANT SLEEP

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Introduction: Infant sleep is influenced by biopsychosocial interactions. However, the influence of an interactive home environment is underexplored. The aim was to examine whether early positive parent-child interactions and an enriched home environment were associated with better infant sleep later.
Methods: Pregnant, obese, and low-income Latina women were recruited for a RCT delivering a 12-month intervention for infants to prevent overweight (n=129). At 1, 6, and 12 months, mothers reported breastfeeding duration, completed the Brief Infant Sleep Questionnaire-Revised (BISQ-R, range: 0-100), and underwent the Home Observation for Measurement of the Environment (HOME, range: 0-45) Inventory including subscales of Responsivity, Acceptance, Organization, Learning Materials, Involvement, and Variety. Pearson correlations between HOME and BISQ-R at each visit were conducted. Significant associations (α<0.05) were entered into stepwise multivariable linear

regressions adjusting for infant sex, mother's education, breastfeeding, and 1-month BISQ-R to determine which HOME subscales were associated with 6- and 12-month total BISQ-R if the total HOME was significant.
Results: The mean 1-, 6- and 12-month BISQ-R were 84(SD=6.1), 76.4(SD=8.3), and 78.5(SD=8.0), respectively. The 1-month HOME total score (M=21.8[SD=4.4]) significantly correlated with the 6- and 12-month BISQ-R. The regression of 1-month HOME with 6-month BISQ-R indicated greater BISQ-R scores were associated with shorter breastfeeding (β=-0.3, p=0.001), greater HOME total scores (β=0.2, p=0.037), and 1-month BISQ-R scores(β=0.2, p=0.038), which explained 13.1% of the variance (F[3,106]=6.5, p<0.001). The regression of 1-month HOME subscales with 6-month BISQ-R indicated greater BISQ-R scores were associated with shorter breastfeeding (β=-0.31, p=0.001), greater Responsivity scores (β=0.21, p=0.022), and 1-month BISQ-R scores (β=0.2, p=0.027), which explained 13.9% of the variance (F[3,106]=6.86, p<0.001). The regression of 1-month HOME with 12-month BISQ-R indicated greater BISQ-R scores were associated with shorter breastfeeding (β=-0.24, p=0.013) and greater HOME total scores (β=0.24, p=0.016), which explained 7.9% of the variance (F[2,100]=5.4, p=0.006). The regression of 1-month HOME subscales with 12-month BISQ-R indicated greater BISQ-R scores were associated with greater Variety scores (β=0.29, p=0.003), shorter breastfeeding (β=-0.24, p=0.011), and 1-month BISQ-R scores(β=0.18, p=0.049), which explained 13.5% of the variance (F[3,99]=6.29, p=0.001).
Conclusion: Better infant sleep was associated with an early interactive home environment, especially parent's responsiveness and people/events providing organized variety.
Support (if any):

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CORTICAL THICKNESS AND SLEEP SLOW WAVE ACTIVITY MEDIATES AGE-RELATED IMPROVEMENTS IN COGNITION DURING LATE ADOLESCENCE

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Introduction: Adolescence is a period of rapid brain maturation, and studies have independently documented reductions in cortical thickness, reduced sleep slow wave activity (0.5-4Hz), and improved cognition as a child transitions into adulthood. In the present work, we investigate whether these factors interact in late adolescence.
Methods: 114 adolescents aged 15-19y (52 males) underwent a structural MRI scan, polysomnography (PSG) and a series of cognitive tests assessing fluid intelligence, sustained attention, speed of processing and working memory. As sleep history has been known to affect EEG measures of slow wave activity, actigraphic recordings ensured that participants received 9h of night the week prior to the PSG session. Cognitive scores were combined to obtain a single measure of global cognition. For assessment of cortical thickness, the Freesurfer (v5.3) pipeline was used to obtain measures for all regions of interest from the Desikan-Killiany cortical atlas. Pearson correlations were conducted to independently confirm associations between aging and reductions in cortical thickness, slow wave activity and improved global cognition, controlling for sex. Finally, a serial mediation model (SPSS PROCESS Model 6) was performed to test the mediating role of cortical thickness and slow wave activity between aging and global cognition.
Results: Reductions in EEG sleep slow wave activity, cortical thickness and improved global cognition was observed with increasing age, likely representing synaptic pruning and a decrease in waking metabolic activity that contributes to increased overall neural efficiency. Regions in the temporal and parietal areas showed the steepest age-related reductions. In addition, the age-related improvement in cognition was found to be mediated by both cortical thinning as well as reduced SWA activity, particularly in the middle temporal cortex.
Conclusion: The adolescent brain undergoes rapid growth in preparation for adulthood. Cortical restructuring through pruning of neural circuits during this period is associated with reduced slow wave activity, mediating the age-related improvement in cognition. Future work should investigate whether insults to the brain during this critical period alters this trajectory.
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EVENING BLUE LIGHT EXPOSURE, MATERNAL GLUCOSE AND INFANT BIRTH WEIGHT

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Introduction: During pregnancy, the use of light-emitting electronic devices before bedtime may contribute to or exacerbate sleep problems. Exposure to blue-wavelength light in particular from these devices may affect sleep by inhibiting melatonin release and causing neurophysiologic arousal which may affect the uterus environment. However, the health consequences of blue-wavelength light on maternal glucose level and fetus development is poorly understood. The purpose of this study was to test the hypothesis that nocturnal blue-light exposure is associated with maternal glucose level and infant's birth weight.
Methods: A group of pregnant women aged 24-39 years old who wore 7-day actigraphy, and completed questionnaires including Pittsburgh Sleep Quality Index participated in the study. Infant's birth weight (n=41) and fasting glucose level (n=30) was abstracted from mothers' medical charts. Blue-wavelength light exposure was obtained from actigraphy recordings. Unadjusted linear regression analyses were performed to determine sleep characteristics that were associated with fasting glucose and infant's weight (p<0.2). Using infant's birth weight and fasting glucose as outcome variables, confounding variables were evaluated in full linear regression models as independent variables.
Results: The mean gestational age was 30.66 (Standard Deviation (SD) 3.46) weeks. The mean fasting glucose, infant's birth weight and gestational age at delivery were 95.73 mg/dL (SD 24.68), 3261 gr (SD 470) and 38.78 (SD 1.69), respectively. In unadjusted analysis, infant birth weight was significantly associated with only blue light value (μW/cm2) (β=76.98, p=0.002) and remained significant (β=78.26, p=0.003) after adjusting for BMI, maternal age and gestational diabetes. Fasting glucose was associated with blue light value (β=2.81, p=0.055) and became significantly associated (β=78.26, p=0.003) after adjusting for sleep duration, parity and gestational diabetes. The coefficient demonstrates that for each unit increase in the evening blue light exposure, there is a 78 gr increase in infant weight after controlling the effect of maternal age, BMI and gestational diabetes.
Conclusion: Evening blue light exposure during mid and late pregnancy may alter maternal glucose regulation and placental nutrient transport to fetus, but these remain to be studied. This study may shed light on future research on the effect of evening light exposure on pregnancy outcomes.
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EVENING LIGHT-INDUCED CIRCADIAN PHASE SHIFT IN PRESCHOOL-AGED CHILDREN

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Introduction: In adults, exposure to light at night delays the timing of the circadian clock in a dose-dependent manner with intensity. Although children's melatonin levels are highly suppressed by evening bright light, the sensitivity of young children's circadian timing to evening light is unknown. This research aimed to establish an illuminance response curve for phase delay in preschool children as a result of exposure to varying light intensities in the hour before bedtime.

Methods: Healthy children (n=36, 3.0 – 4.9 years, 39% males), participated in a 10-day protocol. For 7 days, children followed a strict parent-selected sleep schedule. On Days 8-10, an in-home dim-light assessment was performed. On Day 8, dim light melatonin onset (DLMO) was measured through saliva samples collected in 20-30-min intervals throughout the evening until 1-h past habitual bedtime. On Day 9, children were exposed to a white light stimulus (semi-randomly assigned from 5lx to 5000lx) for 1-h before their habitual bedtime, and saliva was collected before, during, and after the exposure. On Day 10, children provided saliva samples in the evening for 2.5-h past bedtime for a final DLMO assessment. Phase angle of entrainment (habitual bedtime – DLMObaseline) and circadian phase delay (DLMOfinal – DLMObaseline) were computed.

Results: Final DLMO (Day 10) shifted between -8 and 123 minutes (M = 56.1 +/- 33.6 min; negative value = phase advance, positive value = phase delay) compared with DLMO at baseline (Day 8). Raw phase shift did not demonstrate a dose-dependent relationship with light intensity. Rather, we observed a robust phase delay across all intensities.

Conclusion: These data suggest preschoolers' circadian clocks are immensely sensitive to a large range of light intensities, which may be mechanistically influenced by less mature ophthalmologic features (e.g. clearer lenses, larger pupils). With young children's ever-growing use of light-emitting devices and evening exposure to artificial lighting, as well as the prevalence of behavioral sleep problems, these findings may inform recommendations for parents on the effects of evening light exposure on sleep timing in early childhood.

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THE CIRCADIAN VARIATION OF SLEEP IN POSTMENOPAUSAL WOMEN

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Introduction: During menopause, 40-60% of women report sleep complaints. Despite the fact that menopause is associated with fluctuations in sex hormones that can affect circadian physiology, the role of circadian factors in sleep disturbances after menopause is not well understood. The present study aims to understand the circadian variation of sleep occurring after menopause.

Methods: Eight healthy postmenopausal women (PMW; 54.8±3.4 years, one taking hormones) without sleep complaints were enrolled and compared to previously-collected data from 12 healthy young women (YW; 25.8±3.4 years) in mid-follicular phase. Following an 8-h baseline sleep period aligned to their habitual sleep times, participants underwent a 48-h (PMW) or 72-h (YW) ultradian sleep-wake cycle procedure (USW) with 60-min wake episodes alternating with 60-min nap opportunities. Sleep was recorded with polysomnography. Circadian parameters (amplitude, phase) of core body temperature (CBT) and sleep were assessed and compared using mixed-effects linear models on the first 48 hours of USW. Sleep parameters, including total sleep time (TST), arousals, sleep onset latency (SOL), stages N1, N2, N3, REM, and wake, were compared between groups during baseline and USW.

Results: PMW presented earlier habitual bedtimes (23:07±00:11 vs 00:13±00:12) and rise-times (07:07±00:11 vs 08:13±00:12) compared to YW ($p=0.005$). There were no differences in amplitude, phase, or phase angle of CBT. An advanced acrophase of REM sleep ($p=0.034$) and lower amplitudes of TST, arousals, SOL, N3, and wake, were observed in PMW vs YW ($p\leq0.05$). During baseline, PMW presented more stage N1 ($p=0.030$) and arousals ($p<0.001$) than YW. During USW, group effects were observed, with more stage N1 ($p=0.007$) and N2 ($p=0.0007$) in PMW vs YW. Significant interactions showed greater TST ($p=0.009$), shorter SOL ($p=0.001$), and more arousals ($p=0.027$) in PMW during the habitual day.

Conclusion: The primary finding in this small group of PMW with no sleep complaints was a general increase in light sleep and arousals across circadian phases. No differences in CBT rhythms were observed, whereas small differences in the circadian variation of TST, N3, and REM sleep were observed. Further studies are needed to clarify the role of circadian processes on sleep in PMW.

Support (if any): Study supported by the Canadian Institutes of Health Research.

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THE ASSOCIATION BETWEEN SLEEP SPINDLES AND COGNITIVE FUNCTION IN MIDDLE-AGED AND OLDER MEN: A POPULATION-BASED COHORT STUDY

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Introduction: Sleep spindles are thought to play an important role in learning and memory. The association between sleep spindles and cognitive function and the potential confounding influence of obstructive sleep apnea (OSA) is uncertain. We examined the cross-sectional association between sleep spindles and cognitive function controlled for OSA in a sample of community dwelling middle-aged and older men.

Methods: Participants of the Florey Adelaide Male Ageing Study (n=477) underwent home-based polysomnography. These participants also completed the inspection time (IT) task, trail-making test part A (TMT-A) and part B (TMT-B), and Fuld object memory evaluation (FOME) test. Spindle metrics derived from sleep electroencephalography (n=356) included occurrence (total number) and fast (13-16 Hz) and slow (11-13 Hz) spindle density (number/minute) during N2 and N3 sleep. Linear regression models were adjusted for age, OSA, education, obesity, cardiovascular disease, diabetes, smoking, and alcohol risk.

Results: In covariate unadjusted analyses, higher spindle occurrence during N2 sleep was associated with better IT, TMT-A, TMT-B, and

FOME performance (all p<0.05). Spindle density (fast and slow) during N2 and N3 sleep (slow spindles only) was associated with better inspection time, TMT-A, and TMT-B performance (all p<0.05). Fast spindle density during N2 sleep was also associated with better FOME performance (B=1.03, 95% CI [0.47, 1.59], p<0.05). In covariate adjusted analyses, higher spindle occurrence during N2 sleep was independently associated with better IT (B=-0.002, 95% CI [-0.004, 0.000], p=0.046), while fast spindle density during N3 sleep was independently associated with worse TMT-B performance (B=0.12, 95% CI [0.03, 0.21], p=0.011).

Conclusion: Specific sleep spindle metrics during N2 and N3 sleep were independently associated with better visual processing speed and worse executive attention, suggesting a differential association between cognitive function and spindles during N2 and N3 sleep. The utility of sleep spindles for predicting cognitive impairment needs investigation in prospective studies.

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THE ROLE OF EDUCATION ON THE ASSOCIATION BETWEEN OSA AND COGNITIVE FUNCTIONS IN MIDDLE-AGE AND OLDER ADULTS

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Introduction: A weak relation between an increase in education and improved health knowledge was observed among those who attended college, but not among those whose highest educational level attainment was high school (Altindag, Cannonier, & Mocan, 2014). Alachantis and colleagues (2005) had applied cognitive reserve theory (Stern, 2002) to help explain why OSA patients with higher intelligence scores perform well on cognitive tasks. The resource substitution theory (RST; Ross & Mirowsky, 2006) posits that higher education compensates for background disadvantages rather than magnifying background advantages. The goals of the current study were to examine the interaction between educational level and obstructive sleep apnea (OSA) on cognitive functions such as verbal fluency, psychomotor vigilance, executive functions, visuospatial ability, and attention span and to determine whether the results would support the RST.

Methods: One hundred and nine participants (47 ApneaLinkTM -screened controls and 62 untreated OSA patients) participated in the study and completed the Wisconsin Card Sorting Test, WAIS-III digit span and block design, semantic and phonemic fluency tests, and a psychomotor vigilance task. Subjective sleep (PSQI and ESS) and health measures (depression, anxiety, mood disturbance, diabetes, hypertension) were assessed. A hierarchical regression was conducted to test for the additional variance explained by the interaction term even after accounting for the covariates.

Results: In semantic fluency and visuospatial ability tasks, patients with higher education performed better than patients with high school or less education. This moderation effect of education was not observed for the control group. A significant interaction effect was not observed for vigilance, phonemic fluency, attention span, or executive functions although education was a significant predictor for all cognitive tasks.

Conclusion: The resource substitution theory was supported as the benefit of education seemed more crucial for OSA patients than for controls, specifically in semantic fluency and visuospatial ability. This benefit of higher education contributing to larger cognitive reserves in patients with OSA helped buffer some cognitive deficits but not for others, but this buffer no longer works when the cognitive demand gets larger.

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UNDERLYING FACTORS CONTRIBUTING TO SLEEP HEALTH AMONG MIDDLE-AGED AND OLDER ADULTS

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Introduction: Although poor sleep is not inherent with aging, an estimated 50-70 million adults in the US have insufficient sleep. Sleep duration is increasingly recognized as incomplete and insufficient. Instead, sleep health (SH), a multidimensional concept describing sleep/wake patterns that promote well-being has been shown to better reflect how sleep impacts the individual. Therefore, focusing on the underlying factors contributing to sleep health may provide the opportunity to develop interventions to improve sleep health in middle-age and older adults.

Methods: Data from the 2014 wave of the Health and Retirement Study (HRS) were used. Sample size was restricted to those who completed an additional questionnaire containing sleep variables. A derivation of the SH composite was constructed using eight selected sleep variables from the HRS data based on the five dimensions of sleep: Satisfaction, Alertness, Timing, Efficiency, and Duration. Total score ranged from 0-100, with higher scores indicating better SH. Weighting variables were based on complex sampling procedures and provided by HRS. Machine learning-based framework was used to identify determinants for predicting SH using twenty-six variables representing individual health and socio-demographics. Penalized linear regression with elastic net penalty was used to study the impact of individual predictors on SH.

Results: Our sample included 5,163 adults with a mean age of 67.8 years (SD=9.9; range 50-98 years). The majority were female (59%), white (78%), and married (61%). SH score ranged from 27-61 (mean=50; SD=6.7). Loneliness (coefficient=-1.92), depressive symptoms (coefficient=-1.28), and physical activity (coefficient=1.31) were identified as the strongest predictors of SH. Self-reported health status (coefficient=-1.11), daily pain (coefficient=-0.65), being middle-aged (coefficient=-0.26), and discrimination (coefficient=-0.23) were also significant predictors in this model.

Conclusion: Our study identified key predictors of SH among middle-aged and older adults using a novel approach of Machine Learning. Improving SH is a concrete target for health promotion through clinical interventions tailored towards increasing physical activity and reducing loneliness and depressive symptoms among middle-aged adults.

Support (if any): This study was supported by National Heart, Lung, and Blood Institute (NHLBI) UB Clinical Scholar Program in Implementation Science to Achieve Triple Aims-NIH K12 Faculty Scholar Program in Implementation Science

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SLEEP, EMOTION, AND PHYSICAL ACTIVITY IN OLDER ADULTS WHO ENGAGE IN RESONANT BREATHING BIOFEEDBACK

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Introduction: Resonant breathing (RB) biofeedback increases rhythmic heart-respiration coherence patterns and has been associated with improved emotional wellbeing, physiological health, and sleep quality (Lehrer et al, 2000). Sleep quality declines with age, which leads to emotion dysregulation, cognitive impairment, and poor physical health (Crowley, 2011). However, limited research has investigated the sleep characteristics of older adults who practice RB-biofeedback. Therefore, our study investigates this population's sleep characteristics, emotional stability, and physical health.
Methods: Thirty-one healthy participants (24 Female; M=54.68 years, SD=9.74) who self-identified as RB-biofeedback experts completed a series of online questionnaires assessing history, frequency, and duration of practice, sleep (habits and quality), physical activity (frequency, duration, and intensity), and mood (depression symptoms). They also reported their typical coherence level achieved, which is a numerical composite value associated with the heart rhythm's uniform sine-wave pattern at approximately .1HZ (McCraty et al., 2010).
Results: Using bivariate correlations, we found that poor sleep quality was positively correlated with stress ($r = .954$, $p = .001$), poor sleep hygiene ($r = .591$, $p < .001$), severe sleepiness ($r = .518$, $p = .003$), emotion dysregulation ($r = .511$, $p = .004$), depressive symptoms ($r = .089$, $p < .001$), and negatively correlated with subjective happiness ($r = .511$, $p < .003$). Severe sleepiness was negatively correlated with older adults' enhanced physical fitness ($r = .612$, $p < .001$), and poor sleep hygiene was positively correlated with depressive symptoms ($r = .503$, $p = .004$). We found no significant correlations between coherence level, mood, physical activity, or sleep measures.
Conclusion: We found significant associations between healthy sleep habits and emotional wellbeing. Those with better sleep quality and more positive sleep habits also had fewer depression symptoms. Moreover, those categorized as more athletic reported lower levels of severe sleepiness, suggesting that physical activity may be a protective factor for sleep in older adults. We did not find a relation between coherence level and sleep, or physical activity. These null results may be due to the high expertise level of the subject sample. Future studies should compare results to older adults who do not practice RB-biofeedback.
Support (if any): Undergraduate Research Opportunity Program

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AGE, SEX, AND SLEEP CONTINUITY DISTURBANCE: DOES BINARY SEX IMPACT SLEEP CONTINUITY WHILE CO-VARYING FOR AGE ACROSS THE LIFESPAN?

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Introduction: It is well-documented that insomnia symptoms can worsen with age and that women have a greater predisposition to insomnia symptoms than men. Additionally, it has been found that women are more likely to report insomnia symptoms across the lifespan (i.e., increased prevalence of insomnia regardless of age). The aim of the present study was to 1) confirm the finding that women are more likely to endorse having insomnia problems (specifically as they pertain to SL, WASO, and EMA) and 2) evaluate if there are binary sex differences with respect to sleep continuity disturbance (SCD) while accounting for age.
Methods: Sleep continuity (SL, WASO, EMA) duration (in minutes) and problem endorsement data was collected from individuals with insomnia complaints in an archival/community-based sample (n=1837;56.9% female; ages 18-87) (www.sleeplessinphilly.com). A multivariate analysis of covariance was conducted to determine a significant difference between sex (male, female) on SL, WASO, and EMA in minutes while controlling for age. Pearson correlations were run to determine relationships between age and SL, WASO, and EMA. Chi-Square tests were run to determine if there were sex differences in problem endorsement of SL, WASO, and EMA.
Results: Significant sex differences were observed in reports of SCDs as problematic, where more women endorsed SL (58.5%;$p<.001$), WASO (58.1%;$p<.001$), and EMA (56.9%;$p<.001$) as a problem than men. There were no significant effects of binary sex on sleep continuity disturbances when controlling for age. Age was significantly negatively related to SL($p<.001$) and significantly positively related to WASO($p<.001$) and EMA($p<.001$).
Conclusion: These results confirm that women are more likely to report SCDs as a problem and that men and women experience similar levels of insomnia severity with respect to SL, WASO, and EMA. Clinically speaking, it may be important to evaluate insomnia with explicit questions about specific measures of SCD, followed by an inquiry regarding whether each SCD symptom "is a problem." Future studies should consider gender identification as a relevant factor when evaluating for sleep continuity disturbances across the lifespan.
Support (if any):

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ACTIGRAPHY-MEASURED CIRCADIAN FACTORS AND MORTALITY IN US ADULTS: RESULTS FROM THE NHANES

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Introduction: Chronotype is a potentially modifiable contributor to human well-being and longevity, with eveningness commonly linked to poorer outcomes. We examined the relationship between actigraphy-measured chronotype and all-cause mortality in a nationally representative sample of US adults. We also examined the association between social jetlag, a measure of circadian misalignment, and all-cause mortality.
Methods: Data were from 2,256 participants ≥50 from the National Health and Nutrition Examination Survey 2003-2006 cohorts. Participants were asked to wear a hip-worn Actigraph 7164 uniaxial activity monitor for 7 days, and to remove the device for sleep. Objectively-measured bedtime (OBT) was computed as the start of the non-wear period with the longest duration within each 24h period. Duration of the in-bed period (OBT-D) was computed as the hours from OBT to the end of the in-bed period. Midpoint of OBT (OBT-M) was computed as the midpoint between OBT and the end of the in-bed period. Chronotype was estimated using the average OBT-M separately for weekdays, weekends (Friday and Saturday nights), and all days combined. A weekend OBT-M corrected for sleep debt for participants with weekend OBT-D>weekday OBT-D was also computed. The following formula was applied to correct for sleep debt: weekend OBT-M minus ((weekend OBT-D minus weekday OBT-D)/2). Consistent with previous research, OBT-Ms were categorized into intermediate (≥3:30am & ≤4:30am), morningness (<3:30am), and eveningness (>4:30am) chronotypes. Social jetlag was defined as the difference between weekend and weekday OBT-Ms and expressed in hours. Survey-weighted Cox proportional hazard models were used to examine the relationship between circadian factors and all-cause mortality. There were 642 deaths, excluding accidental deaths.

Results: Adjusted for age, sex, race, SES, BMI, smoking and drinking status, comorbidities, and average OBT-D, an eveningness chronotype (i.e., weekend OBT-M corrected for sleep debt) was associated with a greater hazard of death compared to an intermediate chronotype (HR=1.68, 95% CI=1.25, 2.26). There were no other significant associations.
Conclusion: Evening-oriented chronotype is associated with greater mortality risk in adults aged ≥50. To our knowledge, this is the first study to report the link between chronotype, estimated objectively via actigraphy, and all-cause mortality in a nationally representative sample.
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GREATER LIGHT EXPOSURE IS ASSOCIATED WITH MORE ROBUST REST-ACTIVITY RHYTHMS IN COMMUNITY-DWELLING OLDER ADULTS

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Introduction: Disrupted circadian rest-activity rhythms in older adults have been associated with an increased risk of cognitive decline and mortality. While light is one of the most potent synchronizing agents for the human circadian system, little is known about how light may influence rest-activity rhythms in older adults. We aimed to investigate the relationship between the amount of light exposure and rest-activity rhythm parameters using actigraphy data from a large cohort study.
Methods: 553 community-dwelling older adults (aged 72±5, 142 (25.5%) female) from the Chicago Healthy Aging Study cohort underwent recording of activity and ambient light exposure for a minimum of five 24-hour periods, using Actiwatch-L (Phillips Respironics). The average recording duration was 6.7±0.5 days. An extension to the traditional cosine model was used to compute circadian rest-activity rhythm parameters, including the amplitude (a measure of strength), the goodness of fit (pseudo F statistic; a measure of robustness), and acrophase (timing of peak activity). Light exposure was measured by time spent above light thresholds of 100, 200, 500, and 1000 lux per day (TAT100, TAT200, TAT500, TAT1000, respectively). Bivariate associations between rhythm parameters and TAT values were examined with Spearman's correlation coefficients. Variables that met a significant threshold ($p<0.05$) were entered into multivariable models to adjust for potential confounders including age, sex, race, and season.
Results: Robustness of the rest-activity rhythm, measured by extended cosine pseudo-F statistics, was associated with TAT100 (partial Spearman's correlation coefficient 0.12, $p=0.008$), TAT200 (coefficient 0.13, $p=0.03$), TAT500 (coefficient 0.16, $p<0.001$), and TAT 1000 (coefficient 0.18, $p<0.001$). TAT100/200/500/1000 were also associated with the strength of the rest-activity rhythm, measured by amplitude of the extended cosine fit (partial Spearman's correlation coefficient vs. TAT100: 0.12, $p=0.006$, TAT200: 0.14, $p=0.002$, TAT500: 0.16, $p<0.001$, TAT1000: 0.18, $p<0.001$), after adjusting for age, sex, race, and season.
Conclusion: Across the seasons, greater daily light exposure is associated with more robust circadian rest-activity rhythm in community-dwelling older adults. Whether the enhancement of light exposure can improve the strength and robustness of rest-activity rhythm needs to be tested with future intervention studies.
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SEX DIFFERENCES IN THE RELATIONSHIP BETWEEN SELF-REPORTED SLEEP QUALITY AND FRAILTY IN SOUTH FLORIDA OLDER ADULT OUTPATIENTS.

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Introduction: Frailty, a multidimensional construct of decreased reserve is an important predictor of functional independence and quality of life in older adults. There is a growing body of evidence highlighting reduced sleep efficiency and sleep duration predicts frailty in older adults. However, the sex differences in these relationships have been understudied.
Methods: 253 participants (163) ranging in age from 50-92 years (mean= 67.59 years, S.D.= 9.22 years), underwent frailty assessment and completed the Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS). Statistical moderation was assessed using nonparametric bootstrapping. All models statistically controlled for age, education and depression status.
Results: Higher scores on the PSQI predicted higher levels of fatigue ($\beta=1.87$, 95% CI= 0.48-3.27) and higher grip strength with the left hand ($\beta=0.81$, 95% CI= 0.85-1.53). These relationships were significantly moderated by sex ($\beta=-0.77$, $p=0.05$ & $\beta=-0.52$, $p=0.01$). Specifically, high scores on the PSQI predicted more fatigue stronger grip strength in men ($\beta=1.11$, 95% CI=0.41-1.81) and weaker grip strength in women ($\beta=-0.25$, 95% CI=-0.51--0.02). There was no association between scores on the ESS and any of the frailty measures.
Conclusion: The relationships between PSQI scores and measures of fatigue and grip strength were statistically moderated by sex. These differences are not explained by sex differences in overall sleep quality or baseline frailty. This is consistent with the literature emphasizing sex differences in the effects of risk/lifestyle factors. It is possible that the relationship between sleep quality and frailty is altered by additional hormonal factors and warrant further investigation.
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AIR EMISSIONS FROM SWINE INDUSTRIAL LIVESTOCK OPERATIONS AND SLEEP AMONG RESIDENTS IN NEARBY RESIDENTIAL COMMUNITIES

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Introduction: Waste from swine industrial livestock operations (ILOs) produces air pollutants that have been associated with negative health outcomes among nearby residents.
Methods: Using a repeated-measures design, we assessed the impact of odor emissions on sleep duration and awakenings, important components and determinants of health and quality-of-life. Study participants from 16 residential communities in eastern North Carolina hosting swine ILOs, from 2003 to 2005, completed twice-daily diaries in which they rated the strength of hog odors and indicated whether they were asleep or awake per hour for two weeks. Simultaneously, a monitoring trailer placed in a central location in each community measured the atmospheric concentration of hydrogen sulfide (H2S). Subject-conditional fixed-effects regression models were used to estimate associations between two markers of swine ILO pollutant exposures (H2S and swine odor) and two self-reported sleep outcomes (nightly sleep duration and awakening from sleep).
Results: Among 80 participants, nightly (across a 12-hour period) swine odor was associated with lower-nightly sleep duration (mean difference = -14.3 minutes, 95% confidence interval -25.0 to -3.3 minutes) compared to odor-free nights and detection of nightly hydrogen sulfide was associated with a 23% increased hazard of awakening (Hazard ratio = 1.23, 95% confidence interval 0.98 to 1.55) compared to nights with no detection of hydrogen sulfide.
Conclusion: These results suggest that emissions reductions and odor abatement are important public health goals in designing policy and technology solutions to the problems of livestock production and waste management.
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FOOD INSECURITY AND CARDIOMETABOLIC RISKS IN URBAN AMERICAN INDIAN/ALASKA NATIVE (AI/AN) YOUTH: THE ROLE OF SLEEP HEALTH

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Introduction: American Indian/Alaska Native (AI/AN) individuals experience significant health disparities, including poor sleep health and cardiometabolic disease, and these risks emerge early in life. Food insecurity (lack of consistent access to healthy foods) is an important social determinant of health, and AI/AN people are one of the highest risk groups for experiencing food insecurity. Yet, little is known about how food insecurity contributes to health outcomes in urban AI/AN youth. This is the first study to examine the association between food insecurity and sleep (both self-reported sleep disturbance and a composite index of sleep health) and cardiometabolic outcomes in urban AI/AN youth, and whether sleep may be an indirect path between food insecurity and cardiometabolic outcomes.
Methods: Participants were 142 urban AI/AN youth (mean age = 14, 58% female, 53% living in single-parent households). The Child Food Security Survey Module assessed food insecurity. Sleep disturbance was measured using the School Sleep Health Survey. A multidimensional sleep health composite was derived using questionnaire measures (i.e., satisfaction, alertness) and actigraphy-derived indices (i.e., duration, efficiency, regularity, timing). Cardiometabolic measures included body mass index (BMI), blood pressure, glycosylated hemoglobin (HbA1c), waist circumference, cholesterol, and triglycerides. Covariates were sex and age, and single-parent household.
Results: Greater food insecurity was significantly associated with greater BMI ($b = 0.12$, $p = 0.015$), higher systolic blood pressure ($b = 0.93$, $p = 0.03$), and greater sleep disturbance ($b = 1.49$, $p < .001$), and marginally associated with poorer sleep health via the sleep health composite ($b = -0.09$, $p = 0.08$). Food insecurity was not associated with any other cardiometabolic outcomes. There was a significant indirect path from greater food insecurity to greater waist circumference through lower sleep health composite score (0.11, 95% bootstrapping CI: [0.01, 0.30]).
Conclusion: Food insecurity is an important social determinant of sleep and cardiometabolic health. This is the first study of these associations in urban AI/AN youth. Sleep health may be an important, modifiable intervention target to mitigate the negative impact of food insecurity and reduce cardiometabolic risks in this vulnerable population.
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PREVALENCE AND SEVERITY OF SLEEP DISRUPTION AMONGST ASYLUM-SEEKERS IN SOUTH FLORIDA

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Introduction: While research suggests that asylum-seekers often present with a high level of medical and psychological needs, there is a dearth of research exploring sleep quality in this population, and, accordingly, the role that the sleep medicine community may be able to play in alleviating the suffering of this population. Therefore, this study aims to assess the prevalence of sleep disruption amongst asylum-seekers presenting to a South Florida clinic and to categorize these disruptions according to severity and type.
Methods: This is a cross-sectional study utilizing medical affidavits for asylum seekers in South Florida from 2018-2020 (n=54). Affidavits were reviewed for narrative descriptions of sleep quality and information from validated screeners regarding sleep; demographic information was also collected. Affidavits were excluded if they did not include itemized answers to screening questions.
Results: Out of 54 asylum-seekers (31% male, median age=34.5 years), 72.2% reported sleep disturbance. 38.9% reported nightmares, 66.7% reported insomnia of any type, and 29.6% reported severe insomnia. Asylum-seekers that screened positive for post-traumatic stress disorder (PTSD) were more likely to report ongoing sleep disturbance than asylum-seekers that screened negative for PTSD (p=.004). Sleep disturbance prevalence did not vary significantly by gender identity or country of origin.
Conclusion: This study reveals a high prevalence of sleep disruption amongst asylum-seekers in South Florida. The asylum-seekers in our study were more likely to experience insomnia than nightmares, but many experienced both; sleep disturbance was significantly associated

with screening positive for PTSD. Our findings suggest that physicians working with asylum-seekers should ask about sleep quality and offer appropriate care. Directions for further research include investigating how poor sleep quality impacts the health and wellbeing of asylum-seekers.
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QUALITATIVE IDENTIFICATION OF MULTILEVEL INFLUENCES ON SLEEP IN LATINX PRE-ADOLESCENTS

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Introduction: The prevalence of obesity among U.S. Latinx children is nearly 10% higher than in their white counterparts. Long-term success of diet and activity level-focused interventions has been limited. Poor sleep is associated with increased obesity risk in youth. Application of social ecological models of behavior change to identify influences of sleep in Latinx youth may reveal unique intervention targets to improve their sleep, which may reduce obesity risk. This qualitative study aimed to identify the multilevel factors that Latinx pre-adolescents believe affect their sleep duration, quality and timing.
Methods: Eleven focus groups were conducted with forty-six 10-to-12-year-old Latinx pre-adolescents (50% female). Focus groups continued until saturation was reached, and no new information was emerging. Iterative deductive thematic content analysis was conducted by two independent coders (IRR=.815).
Results: Three themes affecting children's sleep resulted: 1) Individual-level (emotional/ physical feelings or behaviors); 2) Social (direct interactions with others); and 3) Environmental (characteristics, objects or perceptions of physical environment) influences. Individual-level influences were primarily psychological (e.g., stress, "Whenever I have a test the next day, I am stressed and I wake up I'm like so tired") and behavioral (e.g., activity levels, "just sitting just the whole day… when it comes to nighttime, you're not even tired"), and affected sleep quality and timing. Interactions with siblings (e.g., "She [sister] always gets mad at me and like in the night she like wakes me up" and friends (e.g., "arguments like with a really good friend… the whole night I think about it") were social factors affecting sleep quality. Environmental influences came from within the sleep area and neighborhood, including temperature (e.g., "I like my pillows cold") and noise (e.g., "My neighbor's dog… they always take them out at night time to like play with them and then I could hear the dog barking and them screaming").
Conclusion: While social influences exist, individual feelings and sleep environment seem to be more prevalent impacts on sleep of Latinx children. Findings support the notion that developing multi-level strategies may be effective in enhancing sleep duration, quality and timing for Latinx pre-adolescents.
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HISPANIC ETHNICITY MAY BE ASSOCIATED WITH SHORT SLEEP DURATION AND ELEVATED SLEEP DISTRESS IN U.S. AIR FORCE TRAINEES

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Introduction: Sleep research among Hispanic populations is limited. Hispanics may be at higher risk of poor sleep when compared to other race/ethnicities. Non-white and other socioeconomically disadvantaged populations have higher rates of chronic health conditions. Epidemiological studies have substantiated the correlation between short sleep and a variety of negative health outcomes. Sleep is foundational to overall good health and functioning, impacting academic and physical performance in technical training, and crucial for an airmen's adjustment to the rigor of a military career. Authors explored the role of race/ethnicity on perceived sleep health (e.g., sleep duration and sleep distress) among airmen attending technical school.
Methods: Sleep health survey was administered to two groups of Airmen at an Air Force technical training: In-processing: Airmen who just arrived to begin technical training, (n=187), Age: M= 20.83 (SD 3.26), 82.55% Male; upon completion of training, i.e., Out-processing: Airmen about to complete technical training, (n=302), Age M = 20.7 (SD 3.09), 85.81% Male. To account for correlations between Airmen from the same squadron, a covariates-adjusted generalized mixed-effects model was used. Associations between race/ethnicity and short sleep duration (≤6 hours), and between race/ethnicity and sleep pattern distress—among shorter sleepers as a sub-group—were examined. Racial/Ethnic frequency among short sleepers (n=135): 19.3 % Hispanic, 13.3% NH-Black, 55.6% NH-White, 6.6% NH-Multiracial, and 5.2% NH-Other.
Results: Among Hispanic Airmen, the out-processing group was 2.25 times as likely as the in-processing group to be short sleepers on weekdays (95% CI: 1.15 to 4.38, p=0.017). Among short sleepers in the out-processing group, Hispanic Airmen were significantly more worried/distressed about their sleep pattern than Black and White Airmen (OR=2.29, 95% CI: 1.18 to 4.42, p=0.014 and OR=2.29, 95% CI: 1.10 to 4.76, p=0.026, respectively).
Conclusion: Short sleep duration is a significant problem in the military and results suggest that race/ethnicity-related contextual factors may point to at risk subgroups. Others have considered the influence of perceived prejudice, access to social capital, cultural barriers to academic success, and potential sensitivity to somatic discomfort on sleep complaints. Future directions involve repeating this assessment with another cohort of technical training Airmen to see if findings replicate.
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HABITUAL SLEEP DURATION AND CHRONIC PAIN IN THE US POPULATION OVER A 10-YEAR PERIOD: IMPLICATIONS FOR SLEEP HEALTH DISPARITIES

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Introduction: Chronic pain is linked with sleep disturbances, which worsen pain experiences. The nature of the bi-directional relationship between sleep and chronic pain has not been explored at the population level, especially among racial/ethnic minorities, a group disproportionately burdened by chronic pain. To address this gap, we investigated the relationship between sleep and chronic pain experiences in the US population and conducted race-stratified analyses.
Methods: Data from the CDC National Health Interview Survey (NHIS) was used, from 2007-2016. Sleep duration was categorized as <=4hrs, 5-6hrs, 7-8hrs, 9hrs, or 10+hrs. N=298,698 provided data for analysis. Chronic pain outcomes included arthritis, joint pain, neck pain, back pain, jaw/face pain, and migraines/headaches. Covariates

included age, sex, body mass index, and employment status. Race/ethnicity was included as a covariate and interaction term, categorized as Non-Hispanic White, Black/African-American, Mexican-American, Other Hispanic/Latino, Asian/Pacific-Islander, Indian/Subcontinent, American Indian/Alaskan Native, and Multiracial/Other. Weighted logistic regression analyses examined sleep as predictor and pain as outcome, adjusted for covariates. Post-hoc analyses examined sleep-by-race/ethnicity interactions.

Results: Prevalence in the population was 24.7%, 40.0%, 4.8%, 15.7%, 29.5%, and 15.0% for arthritis and joint, jaw/face, neck, back, and migraine/headache pain. In adjusted analyses compared to 7-8hrs, arthritis was more likely among <=4hrs (OR=2.6,p<0.0005), 5-6hrs (OR=1.5,p<0.0005), 9hrs (OR=1.1,p=0.002), and 10+hrs (OR=1.2,p<0.0005). Joint pain was also more likely among <=4hrs (OR=2.8,p<0.0005), 5-6hrs (OR=1.6,p<0.0005), 9hrs (OR=1.1,p=0.002), and 10+hrs (OR=1.2,p<0.0005). Jaw/face pain was also more likely among <=4hrs (OR=3.0,p<0.0005), 5-6hrs (OR=1.6,p<0.0005), 9hrs (OR=1.2,p=0.001), and 10+hrs (OR=1.4,p<0.0005). Neck pain was more likely among <=4hrs (OR=3.0,p<0.0005), 5-6hrs (OR=1.6,p<0.0005), and 10+hrs (OR=1.2,p<0.0005). Back pain was also more likely among <=4hrs (OR=3.1,p<0.0005), 5-6hrs (OR=1.7,p<0.0005), and 10+hrs (OR=1.3,p<0.0005). Migraines/headaches were also more likely among <=4hrs (OR=3.6,P<0.0005), 5-6hrs (OR=1.8,P<0.0005), and 10+hrs (OR=1.4,P<0.0005). Significant sleep-by-race/ethnicity interactions were seen for joint (p=0.002), jaw (p<0.0005), and neck (p=0.002) pain, but not back pain (p=0.08), migraines/headaches (p=0.28), or arthritis (p=0.45).

Conclusion: Habitual short and long sleep are associated with a wide range of chronic pain conditions. Bidirectional relationships should be explored as a public health priority. Race/ethnicity interactions suggest that the sleep/pain experience differs by group (reasons should be explored).

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SLEEP DISPARITIES IN PRESCHOOL-AGED CHILDREN

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Introduction: Sleep is known to be associated with socioeconomic status (SES) in older children and adults with those from lower SES households often experiencing poorer sleep quality. Whether this disparity exists in early childhood is relatively unknown, despite being an important age marked by sleep transitions and the establishment of lifelong sleep habits. Furthermore, it is a critical period for cognitive development and learning, which are supported by sleep. Here, we explore associations between sleep and SES in a preschool population. We hypothesized that children from lower SES households would exhibit shorter overnight sleep, longer and more frequent naps, and shorter 24-hr sleep. Additionally, we considered racial and ethnic disparities in sleep which can be confounded with SES in some samples.

Methods: Child (n=441; M age=51.9mo; 45.4% female) sleep was measured objectively using actigraph watches, worn for 3-16 days (M=9.5 days). Caregivers reported child demographics and household data. Race/ethnicity of our sample was 72% White, 10.2% Black, 17.8% other or more than one race, and 28.4% identified as Hispanic. 20.1% of our sample was categorized as low SES. Effects of SES and race/ethnicity on continuous sleep measures were assessed using multiple regression models, with age and gender as covariates. Nap habituality was assessed using chi-square tests.

Results: Lower SES was associated with shorter nighttime sleep duration, longer nap duration, and shorter 24-hr sleep duration (p's<.001). Children from lower SES households were also more likely to nap habitually (p=.04) as were Hispanic children (p<.001). Hispanic children also tended to have longer nap bouts (p=.002). Hispanic and Black children on average had shorter overnight sleep durations than White children (p's<.04), but their 24-hr sleep did not differ.

Conclusion: SES-related sleep disparities were present in this preschool population, with lower SES children exhibiting poorer sleep. When controlling for SES, Hispanic children tended to sleep less overnight which was compensated for by longer, more frequent naps. This underscores the necessity of naps for some children to achieve adequate sleep. Future directions will explore the relationship between parenting factors and sleep, such as bedtime routines and parent knowledge surrounding child sleep needs.

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THE BIDIRECTIONAL RELATIONSHIPS BETWEEN SLEEP, PSYCHOLOGICAL STRESS, AND NEGATIVE MOOD IN DAILY LIFE AMONG HEALTHY LATINX ADULTS

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Introduction: While psychological stress is adversely linked to sleep, the bidirectional and temporal relationships between sleep and psychological stress in the context of daily life are largely understudied, particularly among Latinxs. We examined the bidirectional relationships between daily sleep duration, sleep quality, perceived stress, and negative mood in Latinx adults.

Methods: Between 2016-2019, healthy Latinxs (N=42), defined as those without any major physical or psychiatric morbidities, and free from polysomnography-assessed sleep disorders, were recruited from a community sample in New York. Participants naïve to study hypotheses completed 40 consecutive days of actigraphy and ecological momentary assessment of psychological stress and negative mood (depressed, anxious mood) using a 0 (not at all) to 10 (extremely) scale, contributing 1713 observations. Daily sleep duration was measured via wrist-actigraphy, and perceived daily sleep quality (1[very bad] to 4[very good]) was assessed via morning self-report. Sources of daily stress, including sociocultural stress, were collected once each evening. Multi-level modeling was used to examine within-person effects and temporal associations with adjustment for day of the week.

Results: Mean age=37.2 (SD=11.8), 69.1% women, 36.6% unemployed, 64.3% immigrant, and 38.1% Spanish-speaking. Non-specific stress (43%), work (28%), and family/relationship (21%) stress were the most common sources of daily stress. Discrimination and immigration stress were rarely reported as daily sources of stress (1.2%). Mean nightly sleep duration was 403.9 minutes (±81.3). Preliminary lagged linear mixed models indicated that a 60-minute increase in sleep duration during the night predicted a -.12 change in stress ratings (SE=.001,p<.0001) the next day, as well as -.06 change in anxious mood (SE=.001,p=.003). Better perceived sleep quality on a 4-point scale during the night predicted lower stress ratings (ß=-.11,SE=.05,p=.04) and less anxious mood (ß=-.13,SE=.05,p=.01) the next day. A one-point higher rating of depressed mood during the

day predicted a -.03 decrease in perceived sleep quality that night (SE=.01,p<.05).
Conclusion: Overall, these results imply distinct associations of sleep with both anxiety and depressed mood. Longer sleep duration and improved perceived sleep quality were associated with subsequent decreased stress and anxiety. Increased depressed mood predicted worse sleep quality that night. Future research should identify the mechanisms of action for these differential associations.
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DISCRIMINATION MODERATES THE ASSOCIATION OF SLEEP AND COGNITIVE FUNCTION IN OLDER BLACK ADULTS: THE EINSTEIN AGING STUDY

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Introduction: Experiences of discrimination attributed to a range of individual characteristics (race, skin color, age, sex, etc.) may influence the extent to which sleep impacts cognitive functioning in order adults, particularly within older minorities. Thus, we investigated the effect of discrimination on the relationship between actigraphic sleep quality and cognitive function in analyses stratified by race.
Methods: Participants (N=286, mean age=77.4 years, 32% males; 45% white, 41% Black, 14% Hispanic/others) enrolled in The Einstein Aging Study were included. Sleep disturbance, as measured by wake after sleep onset (WASO) (mean=63 min, sd=27 min), was calculated from wrist actigraphy over 15.4±1.4 days. Participants' mean ambulatory cognitive function was assessed with a validated, memory binding, smartphone-based EMA task (Color Shapes) repeated 4 times daily. A modified version of the Williams' Everyday Discrimination questionnaire, optimized for older adults, measured participants' endorsement of discriminated characteristics. Linear regressions, stratified by race (white, Black separately), were conducted with interaction terms to investigate whether discrimination moderated associations between WASO and ambulatory cognitive function. Models controlled for age, education, income, and gender. Regions of significance were also evaluated.
Results: Race-stratified analysis indicated that the association between mean WASO and cognitive function was significantly moderated by the number of discriminated characteristics among Black adults (n=117), not whites (n=128). Specifically, among Black adults who identified few discriminated characteristics, WASO was not significantly associated with memory binding. However, Black adults who identified discriminated characteristics at +1 SD above the mean (5.5 traits) exhibited a 12% lower average memory binding test score (percent responses correct) with each half-hour greater mean WASO (p=.01). Analysis of the region of significance showed the association is significant when participants endorsed more than three discriminated characteristics.
Conclusion: These findings emphasize the importance of considering sociocultural factors, such as discrimination, to understand the association between sleep quality and cognitive functioning, particularly for older Blacks.
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HOUSEHOLD AND TRANSNATIONAL CAREGIVING AND SLEEP IN LATINX ADULTS: THE MODIFYING EFFECTS OF EMPLOYMENT STATUS

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Introduction: Although caregiving is associated with shorter sleep durations and worse sleep quality, particularly among employed individuals, these studies have mostly examined household (i.e., child, adult) and domestic caregiving among majority non-Latinx White samples. Sending remittances, a form of transnational caregiving whereby financial support is provided to relatives in one's country of origin, is associated with positive mental health among Latinxs, yet its association with sleep remains unexamined. We examined the association of household and transnational caregiving with sleep duration and quality, and explored the moderating effects of employment status on these relationships.
Methods: Using cross-sectional data of healthy Latinx adults in New York City (N=188), we conducted separate age and gender-adjusted linear regressions or logistic regressions to examine the association of caregiving and sleep duration, and poor sleep quality, respectively. Sleep duration (continuous) and sleep quality (fairly/very poor) were measured using two items from the PSQI. Household caregiving was defined as caregiving for children or adults in the household. Transnational caregiving was operationalized as sending remittances. Moderation was tested using employment status*caregiving cross-products in adjusted models.
Results: Participants were Mage=37.61(SD=14.07), 71.3% employed, 66.5% female, and 59.6% immigrants. Overall, 14.9% were household caregivers and 28.72% sent remittances. Household caregiving was not significantly associated with sleep duration or quality. Those who sent remittances reported on average sleeping 27.63 minutes less than non-remitters (b=-27.63,SE=13.93,p<0.05). Sending remittances was associated with 2.30 increased odds of reporting poor sleep quality (OR:2.30; 95%CI:1.03-5.14.) Employment status was a significant moderator (p<0.05). Among those who were employed, sending remittances was associated with 3 times higher odds of poor sleep quality (OR:3.00;95%CI:1.46-10.59) and 48.94 fewer minutes of sleep duration than non-remitters (b=-48.94,SE=15.72,p<0.05). These relationships were not observed among unemployed Latinxs.
Conclusion: Transnational caregivers were more likely to report shorter sleep duration and poorer sleep quality than their counterparts, and this was only observed among employed vs. unemployed Latinxs. Household caregiving was not significantly associated with sleep. Employed transnational caregivers may have multiple jobs that further constrain opportunities for longer and high-quality sleep. Future studies should examine potential upstream factors (e.g., working conditions) that may limit employed, transnational caregivers' ability to obtain adequate sleep.
Support (if any):

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LINEAR AND NONLINEAR ASSOCIATIONS BETWEEN SLEEP AND ACADEMIC ACHIEVEMENT IN MIDDLE CHILDHOOD: THE ROLE OF EARLY LIFE SES

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Introduction: Elementary-aged children in low socioeconomic environments are more likely to experience poor sleep, which can negatively impact academic performance. However, it is unknown whether early-life socioeconomic status (SES) influences associations between sleep and academic achievement later in childhood. Using a demographically diverse sample of children followed longitudinally from 1 to 8 years, we tested linear and nonlinear associations between actigraphy-based sleep duration, midpoint time, sleep duration variability, and parent-reported sleep problems with academic achievement. In addition, we examined whether these associations varied by early SES.

Methods: The sample comprised 707 twins (52% female; Mage=8.44 years; 28.7% Hispanic/Latinx; 29.7% at or below the poverty line). SES was ascertained at 1 and 8 years, and children wore actigraph watches to assess sleep for 7 nights (Mnights=6.79) and completed the Applied Math, Picture Vocabulary, and Passage Comprehension subtests of the Woodcock-Johnson IV Tests of Achievement. Primary caregivers also reported on their children's sleep and academic performance (Children's Sleep Habits Questionnaire and Health and Behavior Questionnaire, respectively).
Results: Sleep was not linearly related to academic achievement, but there was a significant quadratic association between sleep midpoint with Picture Vocabulary (b=0.28, p<.01) and Passage Comprehension (b=0.17, p<.05). More parent-reported sleep problems were negatively related to Applied Problems performance for lower (b=-1.16, p<.001) and positively associated for higher early SES (b = 1.00, p < .01). More parent-reported sleep problems predicted lower Passage Comprehension for lower (b = -0.59, p < .05), but not higher early SES. Longer sleep duration predicted higher parent-reported academic achievement for lower early SES (b=0.14, p<.01) and lower achievement for higher early SES (b=-0.23, p<.001).
Conclusion: Our findings illustrate the complex, sometimes nonlinear associations between children's sleep and academic performance. Many associations varied by early-life SES, suggesting that early childhood environments have long-lasting implications for child functioning, over and above the effect of concurrent SES. Increasing the quantity and quality of children's sleep could improve academic outcomes, particularly for children who have experienced socioeconomic disadvantage.
Support (if any): This research was supported by grants from NICHD (R01HD079520 and R01HD086085) and ASU T. Denny Sanford School of Social and Family Dynamics.

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THE RELATIONSHIP BETWEEN LANGUAGE PREFERENCE AND SLEEP AID UTILIZATION AMONG SPANISH AND ENGLISH-SPEAKING LATINX ADULTS

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Introduction: Studies have found positive associations between acculturation and self-reported sleep disturbances among Latinx adults, however whether acculturation-related factors influence treatment preferences for sleep disturbances remain underexplored. This study examines the relationship between language preference, an indicator of acculturation, and various types of sleep aid use among Latinx adults.
Methods: Using cross-sectional screener survey data from the LAtino Sleep and Health Study (N=739) of Latinx adults living in NYC, we conducted logistic regression analyses to examine the relationship between language preference and 3 types of sleep aid use (prescription, over-the-counter, and natural/herbal). Language preference was determined by whether the survey was completed in English or Spanish. Participants responded "Yes/No" to each type of sleep aid use. Primary regression models included adjustments for gender and age. Sensitivity analyses were conducted accounting for self-reported, physician-diagnosed sleep disorders.
Results: In unadjusted models, participants with Spanish-language preference were 2.38 (OR=2.38, 95%CI:1.30-4.36) and 1.80 (OR=1.80,95%CI:1.27-2.55) times more likely to report prescription and natural/herbal sleep aid use, respectively, compared to those with English-language preference. In primary models, language preference was not significantly associated with any type of sleep aid use. However, being below age 50 was associated with 68% and 44% decreased odds of reporting prescription and natural/herbal sleep aid use, respectively, when compared to those above age 50-79 (OR=0.32, 95%CI:0.16-0.64; OR=0.56,95%CI:0.38-0.84).Those who reported a sleep disorder were 6.35, 2.65, and 2.83 times more likely to report prescription, over-the-counter, and natural/herbal sleep aid use (OR=6.35, 95%CI:3.45-11.69; OR=2.65,95%CI:1.61-4.36; OR=2.83, 95%CI:1.85-4.37) compared to those without sleep disorder.
Conclusion: To our knowledge, this is the first study to examine language preference and sleep aid use in a Latinx sample. After adjusting for demographics, language was no longer significantly associated with prescription or over-the-counter sleep aid use. This change in significance may be due to differences in the age composition of the sample by language preference. Future studies in more balanced age samples should replicate these findings, and further unpack the determinants of prescription sleep aid use in Latinx adults with sleep disorders given the adverse side effects associated with prescription sleep aids.
Support (if any):

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SLEEP DISPARITIES IN ADOLESCENT WOMEN: ROLE OF PUBERTAL DEVELOPMENT, MENSTRUAL CYCLE AND PREMENSTRUAL SYMPTOMS

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Introduction: About 20-30% of children experience sleep difficulties and about 50-60% of those persist into adolescence. Sex differences in sleep become more apparent after the onset of puberty, suggesting a role for maturational changes in the sleep of males and females. In addition, adolescent females experience greater sleep difficulties with the advancement of pubertal stages and around the time of menstruation. Although adult studies have shown sex differences in sleep continuity and architecture, there is a large gap of knowledge in adolescents.
Methods: We analyzed data from the Penn State Child Cohort, a random, population-based sample of 421 adolescents (16.5±2.3y, 53.9% male) who underwent one-night in-lab polysomnography (PSG) and seven-night at-home actigraphy (ACT) as well as a thorough physical exam and clinical history, including self-reports of Tanner staging, menstrual cycle and use of oral contraceptives (OC).
Results: Upon PSG, females had a longer sleep latency (p<0.05), while males a greater number of awakenings (p<0.05), longer wake after sleep onset (p<0.01) and greater stage N1 (p<0.05). Per ACT, females had longer total sleep time and greater sleep efficiency (p<0.01). Sex differences in PSG and ACT parameters were more prominent among adolescents reporting Tanner stages 4-5, including females having greater stage N3 than males (p<0.01) and females reporting premenstrual symptoms (PMS) having a longer sleep latency than males or than those not reporting PMS (P<0.05). Among females, those who had their last period 8-14 days prior to the PSG had a shorter sleep latency than those who had their period within the previous 7 days (p<0.01) or 15-25 days before (p<0.05). Females using OC (n=38) did not show significantly different PSG or ACT parameters than those not using OC (n=156).
Conclusion: Our study provides evidence for sex-related health disparities in objective sleep arising in adolescence. Females sleep objectively better than males from a sleep continuity and sleep architecture perspective, particularly when examined at the same pubertal stage. Additionally, sleep onset is significantly impacted by the menstrual cycle and associated symptoms but females preserve greater levels of deep sleep, a sign of sleep resilience.

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INSOMNIA SYMPTOMS IN LATINX EMERGING ADULTS: THE ROLE OF PERCEIVED DISCRIMINATION

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Introduction: An individual's culture presents unique risk and protective factors related to sleep outcomes. Similarly, emerging adulthood also represents a unique developmental period as it relates to sleep. The study of cultural factors during emerging adulthood is critical for better understanding the development of sleep dysfunction in vulnerable segments of the population. The present study investigated the association between perceived discrimination and insomnia symptoms in Latinx emerging adults. We hypothesized that perceived discrimination would result in higher insomnia symptom presentation above and beyond anxiety and depressive symptoms.
Methods: Participants included 198 (73.7% female; mean age=18.96) college-aged individuals self-identifying as Hispanic/Latinx who completed an online survey that assessed perceived racial/ethnic discrimination (Everyday Discrimination Scale; EDS), anxiety symptoms (General Anxiety Disorder Scale; GAD-7), depression symptoms (Patient Health Questionnaire; PHQ-9), and insomnia symptoms (Insomnia Severity Index; ISI). A three-block hierarchical regression was used to assess the impact of perceived discrimination on the presentation of insomnia symptomology above and beyond demographic characteristics and anxiety and depressive symptoms.
Results: The final model significantly predicted insomnia symptom presentation, $F(5, 191)=26.379$, $p<.001$, $R2=.408$. When age and gender identity were entered into the model they did not significantly predict insomnia symptoms $F(2, 194)=.199$, $p=.82$, $R2=.002$. Blocks 2, anxiety and depression symptoms ($\Delta R2=.388$), and 3, perceived discrimination ($\Delta R2=.018$), accounted for significant change in variance. In the final model, perceived discrimination significantly predicted insomnia symptoms ($\beta=.151$) above and beyond age ($\beta=.016$), gender identity ($\beta= -.085$), anxiety ($\beta= -.075$), and depression ($\beta=.621$).
Conclusion: Results suggest that discrimination among Hispanic/Latinx emerging adults is a unique contributor that may explain some of the higher prevalence rates of insomnia symptomology in this segment of the population. As such, it would be beneficial to tailor existing approaches aimed at improving sleep outcomes by accounting for stressors that could result from or influence discrimination against the individual and incorporate other cultural factors into treatment protocols.
Support (if any): National Institute on Aging (K23AG049955, PI: Dzierzewski).

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ARE SLEEP EDUCATION PROGRAMS EQUITABLE? A META-ANALYSIS ON SLEEP KNOWLEDGE AND BEHAVIORS ACROSS GENDER AND RACIAL/ETHNIC GROUPS

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Introduction: Female and under-represented minority students (URMs) disproportionately experience sleep disturbances. Such sleep disparities may contribute to health disparities and academic achievement gaps. A potential solution is to improve sleep quality via education-based sleep interventions, but it remains unclear whether such interventions produce equitable sleep outcomes across gender and racial/ethnic groups.
Methods: We conducted a meta-analysis on sleep education interventions in high school and college students. We requested that authors provide demographic-separated data on how the intervention changed sleep knowledge, sleep quality, and sleep duration. Data were shared from 12 of the studies that met inclusion criteria (N=964; 64.8% female; 27.6% URM). We used random-effects models and computed Hedges' g for each demographic group for each variable/study separately. We also systematically reviewed the content of each intervention to evaluate diversity, inclusion, and cultural sensitivity metrics.
Results: Sleep education significantly improved sleep knowledge ($g=.82$, $p<.001$) and sleep quality ($g=.14$, $p=.01$), but not sleep duration ($g=.12$, $p=.28$). Pre-to-post change scores indicated that the sleep education intervention was similarly effective for sleep knowledge across males ($g=.80$, $p=.01$) and females ($g=.76$, $p=.002$); sleep knowledge also similarly improved in White/Caucasian students ($g=.94$, $p=.002$), Asian students ($g=.85$, $p=.08$), and URM students ($g=1.24$, $p=.01$). Furthermore, sleep quality improved in Asian students ($g=.28$, $p=.03$), White/Caucasian students ($g=.12$, $p=.09$), and female students ($g=.22$, $p=.008$; but not males; $g=.11$, $p=.22$). Whereas URM students showed the largest improvement in sleep knowledge ($g=1.24$), they showed the least improvement in sleep quality ($g=.07$, $p=.58$). Systematic review of intervention content showed that 75% of interventions were individually-focused (e.g., interviews, participants selected their own goals), but only one sleep intervention was explicitly designed to be culturally sensitive and no interventions addressed financial, social, or neighborhood-level barriers to poor sleep.
Conclusion: Sleep education programs increase sleep knowledge in all student groups, but may not equitably improve sleep quality. Future sleep interventions will need to utilize theories of behavioral change, incorporate cultural tailoring, and address system-level financial, social, and other barriers to sleep quality in URM students.
Support (if any): National Science Foundation (1920730 and 1943323)

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SLEEP HEALTH CONCORDANCE AMONG SOCIOECONOMICALLY DISADVANTAGED CAREGIVER-CHILD DYADS

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Introduction: Child and caregiver sleep typically occurs within a family system. Disadvantaged families experience disproportionately poorer sleep health than more advantaged families. The extent to which objectively measured sleep health metrics (e.g. duration, timing, regularity, efficiency) are concordant within disadvantaged family systems, such as caregiver-child dyads, is not clear. To address this gap, this study aimed to: (1) characterize sleep health metrics, and (2) identify levels of sleep health concordance among disadvantaged caregiver-child dyads.
Methods: 23 disadvantaged dyads were recruited from Philadelphia and Delaware communities. Dyads were eligible if the child was between 6-14 years, slept in the same house as the caregiver at least four nights/week, had no diagnosis of a sleep disorder or use of sleep medication, and qualified for federally funded food assistance programs (e.g., food stamps, WIC or SNAP benefits). Sleep health of the dyads

was objectively measured for 7-14 days. Sleep metrics used to characterize the sample were: nighttime sleep duration (hours), time-to-bed, sleep regularity (standard deviation of sleep duration), sleep midpoint (halfway point between sleep onset and wake time) and efficiency (percentage of time spent asleep versus awake). Concordance in sleep health metrics within dyads was calculated using Pearson's correlation coefficients of the average sleep metrics over the monitoring period.
Results: Children (46.2% female) slept, on average, 7.96 hours per night, with 1.25 hours of nightly sleep variability, bedtime of 10:47 PM, sleep midpoint of 2:56 AM, and sleep efficiency of 83.55%. Caregivers (mean age = 40.5 years, 85.0% female) slept, on average, 6.92 hours per night, with 1.22 hours of nightly sleep variability, bedtime of 11:24 PM, sleep midpoint of 3:04 AM, and sleep efficiency of 76.29%. Bedtime ($r = 0.19$, $p < 0.001$), sleep midpoint ($r = 0.39$, $p < 0.001$), and sleep efficiency ($r = 0.24$, $p < 0.001$) were significantly concordant among caregiver-child dyads.
Conclusion: Given their level of concordance, bedtime, sleep midpoint and efficiency are modifiable factors of sleep health in disadvantaged dyads that could be targeted using family versus individual level interventions.
Support (if any): University of Delaware General University Research Grant and School of Nursing SEED funding.

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NEIGHBORHOOD SAFETY, STRESS, AND SLEEP: ETHNIC DIFFERENCES
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Introduction: Feelings of safety in an individual's neighborhood have an influence on mental health, specifically, feelings of unsafety can result in emotional distress. Given the role of stress on sleep, ethnic differences in stress levels are of particular importance. The current study investigated the influence of feelings of neighborhood safety on stress and sleep, and whether this influence differs by ethnicity. The mediating role of feelings of neighborhood safety on the relation between stress and sleep was also explored.
Methods: 947 participants were recruited to participate in a questionnaire through Amazon Mechanical Turk, university SONA system, and social media. Components of this survey included the Pittsburgh Sleep Quality Index (PSQI), Perceived Stress Scale (PSS), and the Neighborhood Questionnaire Neighborhood Safety Subscale. In addition, information was collected about participants' living surroundings.
Results: Feelings of unsafety in one's neighborhood result in higher stress levels and poorer sleep. These differences were greater for Black Americans, Asian Americans, and Latino Americans, compared to White Americans. Feelings of lower neighborhood safety result in higher stress, leading to poorer sleep.
Conclusion: The effects of neighborhood safety on stress and sleep are of particular interest due to the ethnic differences present. Given the health disparities present for minority ethnic groups in the United States, the factors involved in feelings of neighborhood safety should be further investigated.
Support (if any):

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INFLUENCE OF FEELINGS OF NEIGHBORHOOD SAFETY ON ANXIETY AND SLEEP
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Introduction: Sleep is a significant factor in the regulation of mood and behavior in individuals, with loss of sleep potentially leading to negative effects such as behavioral or emotional difficulties (Dahl 1999; Baum, Desai, Field, Miller, Rausch, & Beebe, 2014). Neighborhood safety plays a critical role in the perception of stress, with the negative perception of safety predicting higher mental distress, thus leading to rumination and increasing the difficulty for the individual to fall asleep (Henderson, Child, Moore, Moore, & Kaczynski, 2016; Dahl 1996). The goal of this study is to analyze how feelings of neighborhood safety and neighborhood demographics influence anxiety and sleep.
Methods: A subset of 200 participants from a larger data collection were recruited to participate in a questionnaire administered through Amazon Mechanical Turk, university SONA credit system, and social media. Measures include the Pittsburgh Sleep Quality Index, Neighborhood Questionnaire Safety Subscale, and the Spielberger State-Trait Anxiety Inventory.
Results: Poorer sleep quality is predicted by higher feelings of anxiety and lower feelings of safety in ones neighborhood.
Conclusion: The specific factors contributing to the anxiety resulting from feelings of lower neighborhood safety are an area that require further investigation with a broader sample.
Support (if any):

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RACIAL AWARENESS AND INSUFFICIENT SLEEP
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Introduction: Population-based studies are needed to fully disentangle persistent racial and ethnic disparities in sleep health in the US. In this study, we examine whether the frequency of self-reflection on racial identify influences insufficient sleep among US adults.
Methods: The 2010 Behavioral Risk Factor Analysis Surveillance System (BRFSS) was used as the primary data source to explore the relationship between self-reflection of racial identity and insufficient sleep. Data was limited to states administering the "Reactions to Race Module," which included Georgia, Kentucky, and Rhode Island (N=7,085). Frequency of self-reflection of race was assessed using the question "How often do you think about your race? Would you say never, once a year, once a month, once a week, once a day, once an hour, or constantly?" Insufficient sleep was determined using the item, "During the past 30 days, for about how many days have you felt you did not get enough rest or sleep?" Multivariate regression analyses were performed while controlling for age, sex, education, income, marital status, and poor mental and physical health.
Results: Results: Across the sample, participants reported an average of 8.95+/- 10.06 days of insufficient sleep per month. Participants from Georgia reported the highest number of days of insufficient sleep (9.83+/- 10.51) followed by Kentucky (8.64+/- 9.94) and Rhode Island (8.38+/- 9.67) ($p<0.05$). After controling for age, sex, education, income, employment, and marital status, individuals reporting any self-reflection on their race were more likely to report insufficient sleep within a 30-day period (Beta=0.026, 95% CI [0.062, 1.02], p=0.027).
Conclusion: Conclusion: In a sample of US adults, self-reflection of race adversely impacted sleep quality. More studies are needed to fully explore the mechanisms underpinning this association.
Support (if any):

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ASSOCIATIONS BETWEEN DIET AND SLEEP HEALTH IN THE UK BIOBANK STUDY

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Introduction: It is well known that the prevalence of clinical and subclinical sleep issues is quite high, with a great economic and social burden on the society. As it is expected that the numbers of people suffering from clinical and subclinical sleep problems will increase in the coming years, new primary and/or complementary methods to improve and prevent poor sleep health across the population are urgently needed. In the current study, we aimed to conduct the largest investigation of diet and sleep health to date, through systematically examining the UK Biobank (UKB) data to find out whether diet quality and food groups play a role on sleep health.
Methods: This cross-sectional population-based study involved 502,494 participants. UKB food frequency and sleep questionnaires at baseline were used. Also, healthy diet, healthy sleep, and partial fibre intake scores were created. ANCOVA and regression models were used to examine the associations of healthy diet and dietary fibre intake scores with sleep health. Adjusted models included age, sex, BMI, and mental health symptomatology.
Results: We showed that both healthy diet and high partial fibre intake scores were associated with increased healthy sleep scores. Also, higher intakes of vegetables, fruits, fish, and unprocessed red meat were found to be associated with increased healthy sleep scores. On the other hand, processed meat intake was inversely associated with sleep health.
Conclusion: A healthy dietary pattern, and food groups (vegetables, fruits, fish, water) and nutrients (fibre) that are consumed as a part of a healthy dietary pattern were associated with better sleep health. Further work is needed to identify underlying mechanisms behind the impact of diet on sleep health.
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SLEEP AMONG YOUTH DURING THE COVID-19 PANDEMIC: DIFFERENCES BETWEEN SUMMER AND SCHOOL-YEAR

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Introduction: Insufficient sleep is highly prevalent among school-age youth and adolescents, which has been exacerbated by the COVID-19 pandemic. However, it is unclear whether sleep during COVID-19 varies based on whether school is in session. We examined the sleep of school-age youth and adolescents during COVID-19 and described changes in rates of insufficient sleep from summer (Time 1) to school year (Time 2). We further examined whether insufficient sleep is associated with mental health service utilization.
Methods: Adults in Southwestern Pennsylvania with children under 18 years old in their household completed a repeated cross-sectional electronic survey. The survey was designed to assess usage of, and unmet need for, health and social service resources, among other health behaviors. As responses were anonymous with no longitudinal linking, we used descriptive statistics and Chi-Square tests to examine our aims at each time point. Insufficient sleep was operationalized as <9 hours (school-age youth) and <8 hours (adolescents) of sleep duration, per National Sleep Foundation standards.
Results: Data were analyzed from n=97 school-age youth and n=83 adolescents at Time 1, and n=77 school-age youth and n=82 adolescents at Time 2. Most school-age youth (76.3%) obtained sufficient sleep at Time 1, which was maintained at Time 2. However, while 75.6% of adolescents obtained sufficient sleep at Time 1, that number fell to 63.3% at Time 2. Youth with insufficient sleep were more likely to utilize mental health services than those obtaining sufficient sleep at a borderline level of statistical significance (p-value = 0.097), after controlling for age group.
Conclusion: The rate of insufficient sleep among adolescents during COVID-19 is meaningfully higher than non-COVID, school-year rates recently reported among adolescents. Youth with insufficient sleep are more likely to utilize mental health services, though the direction of causality in that association is unknown. Future work should focus on strategies for increasing access to sleep promotion programs that support sleep health and mental health during a time of great stress.
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MENTAL HEALTH CLUSTERS DURING COVID-19 PANDEMIC ARE ASSOCIATED WITH MULTIPLE DIMENSIONS OF SLEEP IN A SAMPLE OF PREGNANT WOMEN

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Introduction: Sleep and mental health have a bidirectional relationship. During pregnancy, poor sleep health, depression and stress are common and have been associated with poor maternal and fetal outcomes. The COVID-19 pandemic has introduced additional physical and psychological risk factors, due to high mortality rate, and economic and social repercussions. This study examines whether prenatal maternal mental health clusters are associated with multiple dimensions of sleep during pregnancy in the context of the COVID-19 pandemic.
Methods: From June-December 2020, participants were recruited as part of the COVID-19 Mother Baby Outcomes (COMBO) Cohort at Columbia University (N=188; at recruitment gestational age: 32.2±8.2 weeks; age: 32±6.75 years; N=74 Hispanic, N=65 White non-Hispanic, N=27 Black/African American, N=22 other). Survey data on maternal depression (PHQ-9), perceived stress (PSS), Covid-related stress, and sleep health (PSQI) were collected. Using hierarchical clustering, we created maternal mental health clusters (MMHC). Regressions analyses were implemented to estimate the associations between multiple dimensions of sleep based on MMHC.
Results: \We derived three MMHC: Low-risk (no depression, no Covid-stress, low-moderate perceived stress), Covid-stress (no depression, moderate Covid-stress, low-moderate perceived stress) and high-risk (moderate depression, moderate Covid-stress, moderate to high perceived stress). Maternal age, gestational age, income, and race were not significantly different across clusters. The Covid-stress cluster compared to the low-risk cluster reported worse subjective sleep quality (ß=0.34±0.11, p=0.0025),

longer sleep latency (ß=0.44±0.13,p<0.000), more sleep disturbances (ß=0.67±0.18, p=0.004) and an overall higher PSQI score (ß=0.32±0.13,p=0.017). Compared to the low-risk group, the high-risk group reported worse subjective sleep quality (ß=0.96±0.3,p<0.000), longer sleep latency (ß=0.79±0.13,p<0.000), shorter sleep duration (ß=0.67±0.18,p=0.0003), lower sleep efficiency (ß=0.67±0.25,p=0.008), more sleep disturbances (ß=0.59±0.10, p<0.000), higher daytime dysfunction (ß=0.85±0.10, p=0.000) and an overall higher PISQI score (ß=1.15±0.16, p<0.000).

Conclusion: Our results indicate that the COVID-19 pandemic has affected mental health profiles during pregnancy, with evidence of a high-risk cluster presenting Covid-stress and depressive symptoms and a Covid-stress cluster presenting Covid-stress without depressive symptoms in a multi-ethnic sample of pregnant women. Both were associated with poorer sleep health outcomes compared to the low-risk cluster. These results have important implications for screening and treatment for the sleep health and obstetric communities during these unprecedented times.

Support (if any):

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RACIAL DISPARITIES IN SLEEP DURING THE COVID-19 PANDEMIC.

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Introduction: The purpose of the present study was to estimate average sleep duration and sleep disturbance in the United States during the COVID-19 pandemic. In addition, we investigated whether sleep varied as a function of sociodemographic variables, in particular race. Long standing disparities in condition and available resources between racial demographics often lead to disparities in health. At the advent of a pandemic, which strains these systems further, it is important to assess whether or not racial disparities persist. This is important given that racial groups are likely affected by the pandemic, both directly and indirectly, in various ways. Here, we plan to at least assess whether there are any disparities with regard to sleep.

Methods: 4,048 adults (Mage = 45.8 years; 79% women) completed an online survey during April – June 2020. The final sample's self-reported race/ethnicity consisted of 84% White, 5.1% Black, 3.4% LatinX, 4.2% Asian or Asian American, and 2.9% Multi-racial. Sleep disturbance was assessed using a retrospective sleep diary and the Insomnia Severity Index (ISI).

Results: Average sleep duration in the sample was 7.1 hours. Participants reported taking on average 32 minutes (SD = 38 mins) to fall asleep and reported waking up for 32 minutes (SD = 53 mins) during the night. Approximately 17% of the sample endorsed clinically elevated insomnia symptoms (based on the ISI ≥ 15 cut-off). With regard to racial differences, shorter total sleep time (TST), longer sleep latencies (SL), and greater total ISI scores were observed in Black (mean TST = 6.4 hours; SL = 37.7 minutes; ISI Total = 9.8) and LatinX (mean TST = 6.9 hours; SL = 37.1 minutes; ISI Total = 9.6) participants relative to White participants (Mean TST = 7.1 hours; SL = 30.9 minutes; ISI Total = 8.4). All p's < 0.05.

Conclusion: Sociodemographic variables, particularly race, should be considered when estimating the relative impact of sleep on overall health. These findings are significant as they may have implications for a number of health disparities observed in the United States, especially during the COVID-19 pandemic.

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CHANGES IN SLEEP HYGIENE AND SLEEPINESS FOLLOWING SOCIAL DISTANCING RELATED TO COVID-19

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Introduction: It was expected COVID-19 would result in changes that could impact sleep hygiene and sleep. We examined sleep hygiene and symptoms of disrupted sleep through late April and May and demographic and psychological variables related to vulnerability/resilience to negative outcomes.

Methods: Participants (Part1: N=180, Part2: N=64; ages 18-85) solicited from a college (students, faculty/staff, alumni, parents) and local community (churches, community centers, libraries) completed a 30-minute survey (measures: sleep hygiene (SH), symptoms of sleep disruption, mental health, personality, social distancing, COVID-19 impact/experience, and demographics) for possible prizes. Part 1, April 20th-May 12th, participants answered trait questionnaires and state questionnaires for before and during social distancing, then repeated state questionnaires two weeks later (Part 2).

Results: Following initial COVID related changes, 66.1% of participants reported worsening symptoms of sleep disruption, 27.9% reported no change, and 6.3% reported improvements. 40.3% reported worsening SH, 53.5% no change, and 6.3% improvements. At 2-week follow-up, 30.4% of participants shifted from reporting no change to SH improvements over baseline. Overall, participants showed significant worsening of symptoms of sleep disruption (sleepiness, moodiness, avolition, cognitive impairments) and SH behaviors (less consistent bed- and wake-times, more frequently staying too long in bed, more pre-bed alerting activities, more bedtime negative emotion, more use of bed for purposes other than sleep, more active technology use) (d's from .23-1.00). Worsening sleep hygiene with COVID-19 was significantly predicted by younger age (r(157)=.164, p<.05), more avoidant coping (r(151)= -.337, p<.05), lower life satisfaction (r(156)=.200, p<.05) and greater impact/experience of COVID-19 (r(150)= -.270, p<.05). Symptoms of sleep disruption showed similar, but larger, relationships.

Conclusion: Initial social distancing may have disrupted routines, added stress, and resulted in worsened sleep and sleep hygiene. Over time some adapted and improved, but most did not. Our results suggest change, especially crises such as a pandemic, may alter established behavior for the worse and/or add significant stress. Without intervention, even the robust, i.e., young, may suffer. Variables identifying those more vulnerable to disrupted sleep following change and those more likely to experience worsening sleep may help identify targets for future interventions.

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CHANGING NATIONAL TRENDS IN SLEEP AND RELATED FEATURES AMONG KOREAN ADULTS BETWEEN 2009 AND 2018

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Introduction: Sleep patterns have been linked to various heath disease. Evaluating population-level trend of sleep could provide a

comprehensive population health-forecasting model that has the potential to inform targeted interventions. Therefore, we aimed to examine the cross-sectional differences in sleep characteristics among Korean adults during a 9-year period of 2009-2018.

Methods: The data in this study were derived from two nationwide survey regarding sleep and headache in the representative sample of Korean adult population, namely the Korean Sleep Headache Study phase I (2009) and II (2018). The survey was conducted through door-to-door visit and face-to-face interview by using structured questionnaires. Total of 2,836 participants from Phase I (47.9±16.4 years old; female, 50.2%) and 2,501 participants (47.9±16.4 years old; female, 50.3%) from Phase II gave informed consents and completed the survey. For this study, we excluded those who worked as shift workers and missing data. From the MCTQ, we collected participants' sleep schedule during workdays and free days over the past four weeks. Average sleep duration was a weighted mean of sleep duration on workdays and free days. Poor sleep quality was defined as PSQI >5. Excessive daytime sleepiness and Depression are performed with ESS and PHQ-9, respectively.

Results: During the 9 years, average sleep duration decreased by 21 minutes, especially more reduction on free days (workday: 7:17±1:58 vs. 7:06±1:06, p <0.001; free days 8:04±2:32 vs. 7:49±1:23, p <0.001). People go to sleep and wake up earlier on workday (workday 23:39±1:50 vs. 23:25±1:30, p <0.001; free days 23:51±2:11 vs. 23:25±2:11, p <0.001), whereas they go to bed earlier and wake up later on free days compared to past (workday 6:52±1:36 vs. 6:37±1:11, p <0.001; 7:42±2:04 vs. 7:49±1:42 p =0.023). Social jetlag was increased by 5 minutes (0:46±1:35 vs. 0:51±0:52, p =0.028). There was the difference of age on the habitual sleep-wake rhythm and sleep related symptoms. Also, short or long sleep duration was associated with a significant increase in each health outcomes.

Conclusion: Decreased sleep duration seems to be on the rise in the general adult population, which lead to a poor health status. Interventions to promote adequate sleep is urgently needed.

Support (if any):

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DREAM FEATURES OF THE ITALIAN POPULATION ACROSS THE FIRST AND SECOND WAVE OF THE COVID-19 PANDEMIC

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Introduction: The Italian government has responded to the second wave of the COVID-19 pandemic (autumn 2020) with a partial lockdown (PL). Here we aim to investigate the effects of the PL on dream features in the Italian population and to follow up on previous data collected during the total lockdown (TL) effected during the first wave of the pandemic (spring 2020).

Methods: Using a longitudinal approach, 214 participants (Mage=36.78±14.2y; 159F) who had participated in a previous survey (April 2020 – TL) completed the same online survey from November 10th to December 1st (PL). The questionnaires administered included the Pittsburgh Sleep Quality Index (PSQI) and a set of specific ad hoc questions on dream features (frequency, length, vividness, emotional tone, relation of content to the current health emergency) and their possible changes relative to the month preceding the lockdown, resulting in four time points (pre-TL, TL, pre-PL, PL).

Results: Frequency and length of dreams significantly increased from pre-PL to PL (both p's<.01), while no difference emerged for vividness. As in TL, almost 30% of the subjects reported having COVID-19-related dreams during PL and, among these, 51% reported to face, in these dreams, problematic situations similar to those of their daily life. Both PSQI and dream negative emotionality scores significantly increased from pre-TL to TL, decreased in pre-PL and increased again in PL, indicating a parallel worsening of sleep quality and dream emotionality with both lockdowns. Dream negative emotionality in PL also showed positive correlations with PSQI scores and with negative mood, stress levels, general fear and fear about the COVID-19.

Conclusion: In line with the continuity hypothesis on the relationships between dreaming and the wake state, our data confirm that dream features are significantly and immediately affected by major life changes such as those brought about by the COVID-19 pandemic and related restrictions. Interestingly, dream emotionality and subjective sleep quality show a parallel profile across the different time points, suggesting the possible role of sleep quality as a modulating factor on dream affect.

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SELF-REPORTED SLEEP FEATURES IN THE ITALIAN POPULATION ACROSS THE FIRST AND SECOND WAVE OF THE COVID-19 PANDEMIC

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Introduction: Several studies have shown the negative impact of COVID-19-related confinement measures (spring 2020) on sleep features and quality. Here we aim to follow-up on these data by assessing self-reported sleep characteristics during the second wave of the pandemic (autumn 2020) in Italy, where the government responded with a second, partial, lockdown.

Methods: Using a longitudinal approach, 214 participants (Mage=36.78±14.2y; 159F) who had participated in a previous survey (April 2020 – Total Lockdown, TL) completed the same online survey from November 10th to December 1st (Partial Lockdown, PL). In each survey, participants had to respond to a set of questionnaires, including the Pittsburgh Sleep Quality Index (PSQI), referring to their current situation and, retrospectively, to their situation before the lockdown, resulting in four time-points (pre-TL, TL, pre-PL, PL).

Results: Linear mixed-model analysis showed that bedtime was delayed from pre-TL (23:46) to TL (24:42) and then linearly advanced in pre-PL (24:02) and PL (23:56). The same pattern emerged for rise time (pre-TL: 07:48, TL: 9:05, pre-PL: 8:28, PL: 7:58) and time in bed, which increased from pre-TL (8h4min) to TL (8h24min) and then linearly decreased (pre-PL: 8h15m, PL: 8h2m). Subjective sleep quality decreased in the two lockdowns compared to the period with no restrictions. The proportion of poor sleepers (PSQI>5) increased from 39.7% (pre-TL) to 48.6% in TL and again from 36.9% (pre-PL) to 47.7% in PL.

Conclusion: Sleep habits and quality showed different profiles across four time-points of the COVID-19 pandemic and related restrictive measures. Sleep timing alterations appeared during the first lockdown, recovered after the confinement period, and almost returned to baseline during the second lockdown (likely due to a normalization of working schedules). Instead, subjective sleep quality markedly worsened during

both lockdowns relative to the preceding respective months. These data suggest that subjective sleep quality is particularly sensitive to changes in life habits and psychological factors, independently of sleep habits. Considering that the pandemic situation may continue for several months, there is a need for interventions targeting sleep quality.
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SLEEP VARIABILITY AND AFFECT DYNAMICS AMONG COLLEGE STUDENTS DURING COVID-19 PANDEMIC

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Introduction: Sleep disturbance is a transdiagnostic risk factor that is so prevalent among emerging adults it is considered to be a public health epidemic. For emerging adults, who are already at greater risk for psychopathology, the COVID-19 pandemic has disrupted daily routines, potentially changing sleep patterns and heightening risk factors for the emergence of affective dysregulation, and consequently mood-related disturbances. This study aimed to determine whether variability in sleep patterns across a 3-month period was associated with next-day positive and negative affect, and affective dynamics, proximal affective predictors of depressive symptoms among young adults during the pandemic.
Methods: College student participants (N=20, 65% female, Mage=19.80, SDage=1.0) wore non-invasive wearable devices (the Oura ring https://ouraring.com/) continuously for a period of 3-months, measuring sleep onset latency, sleep efficiency, total sleep, and time spent in different stages of sleep (light, deep and rapid eye movement). Participants reported daily PA and NA using the Positive and Negative Affect Schedule on a 0-100 scale to report on their affective state.
Results: Multilevel models specifying a within-subject process of the relation between sleep and affect revealed that participants with higher sleep onset latency (b= -2.98, p<.01) and sleep duration on the prior day (b= -.35, p=.01) had lower PA the next day. Participants with longer light sleep duration had lower PA (b= -.28, p=.02), whereas participants with longer deep sleep duration had higher PA (b= .36, p=.02) the next day. On days with higher total sleep, participants experienced lower NA compared to their own average (b= -.01, p=.04). Follow-up exploratory bivariate correlations revealed significant associations between light sleep duration instability and higher instability in both PA and NA, whereas higher deep sleep duration was linked with lower instability in both PA and NA (all ps< .05). In the full-length paper these analyses will be probed using linear regressions controlling for relevant covariates (main effects of sleep, sex/age/ethnicity).
Conclusion: Sleep, an important transdiagnostic health outcome, may contribute to next-day PA and NA. Sleep patterns predict affect dynamics, which may be proximal predictors of mood disturbances. Affect dynamics may be one potential pathway through which sleep has implications for health disparities.
Support (if any):

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REVEALING THE SEX DATA GAP IN SLEEP AND CHRONOBIOLOGY RESEARCH: A SYSTEMATIC REVIEW

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Introduction: Many aspects of sleep and circadian physiology appear to be sensitive to characteristics of the studied population, most notably sex. While recent research robustly highlights the importance of considering participant-level demographic information, it is not clear to what extent this information is available in the large body of already published literature. In this systematic review, we evaluated the study sample characteristics in the published sleep and chronobiology research over the past 40 years.
Methods: Articles published between 1979 and 2019 (odd years) in the top eight sleep and chronobiology journals, identified by their five-year Impact Factor, were found through MEDLINE. 6,777 articles were initially included for screening. Inclusion requirements included conducting original research, reporting human data, and recruiting volunteers. The reporting of sample size, age, sex, gender, ethnicity, level of education, socio-economic status, and profession of the study population was scored binarily (0 = not reported), and any reported aggregate summary statistics for these variables were recorded. Funding source, geographical location and clinical focus of the article were examined, as well as whether data were analyzed including any of the demographic variables as covariates.
Results: ~75% of screened articles met inclusion criteria. While >90% of studies reported age or sex, all other variables were reported in <10% of cases. We found that sex balance greatly changed over the years, from a ~3:1 male to female ratio in the 1990s to a near-equal representation in the 2010s. Overall, ~75% of studies recruited both male and female participants. Of studies recruiting a single sex, ~50% all-female studies focused on a sex-dependent feature, compared to <5% in all-male studies.
Conclusion: In this comprehensive review, we found that the majority of studies report at least sex or age, while many other important variables are typically not reported. Reporting quality is highly variable, indicating an opportunity to standardize reporting guidelines for participant-level characteristics to facilitate disaggregated data analyses.
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ASSOCIATION BETWEEN PET OWNERSHIP AND SLEEP IN THE SWEDISH CARDIOPULMONARY BIOIMAGE STUDY (SCAPIS)

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Introduction: Preliminary findings suggest that pets may improve the owner's sleep via companionship, security, physical activity, and relaxation. On the other hand, pets can disrupt the owner's sleep. Due to the heterogeneity of the results and the low number of studies in this field, more studies with a bigger sample size are needed to explore this association.
Methods: Using data from the Swedish CArdioPulmonary bIoimage Study (SCAPIS) cohort, we investigated the association of pet ownership with the following self-reported sleep outcomes in 3,788 to 4,574 participants using regression modeling: achieving the recommended daily sleep duration for adults (i.e., at least 7 hours per day); sleep quality as measured by the Pittsburgh Sleep Quality Index (a score of >5 indicating poor sleep quality); and difficulty falling or staying asleep.
Results: Sleep metrics were not associated with pet ownership, dog ownership, and dog walking when controlling for possible confounders. In contrast, cat ownership was associated with a higher odds ratio of failing to achieve the recommended duration of 7 hours of sleep per day (1.18 [1.02,1.37] vs. non-cat owners). This association persisted

even after adjusting for various factors known to affect sleep (e.g., shift work, lack of social interaction, and chronic stress).
Conclusion: We found that owning a cat was associated with increased odds of sleeping less than the recommended seven hours per day. General pet ownership and dog ownership were not associated with either of the sleep outcomes. Whether this means that cats represent a risk factor for short sleep duration cannot be derived from the present observational study. Future studies should more thoroughly investigate the various aspects of cat ownership, e.g., the cat´s breed, age, and co-sleeping with the cat.
Support (if any):

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SLEEPING THROUGH A PANDEMIC: SLEEP HEALTH IN ADULTS AROUND THE WORLD DURING THE COVID-19 LOCKDOWN

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Introduction: The novel COVID-19 disease rapidly escalated into a global pandemic affecting people around the world. While communities imposed mitigation measures to stop the spread of the disease, the mass (home) confinement in addition to the uncertainty of the pandemic led to drastic changes in all aspects of life, including sleep. Sleep health is strongly linked with mental and overall health and could play a protective role against the development of mental distress during the pandemic. Here, we investigated sleep health in a global multicultural sample of adults during the COVID-19 pandemic.
Methods: We surveyed 6,882 adults (18-94 years) across 59 countries about their sleep health (RU-SATED scale), sleep behaviors, demographics, pandemic-related factors, and mood between late April and early May 2020. A hierarchical stepwise multiple linear regression was performed to investigate correlates of sleep health.
Results: Compared with pre-pandemic times, more than one third of the sample reported an increase in sleep disturbances, and more than half of the sample shifted their sleep schedule towards later bed- and wake-up times. Better sleep health was associated with being partnered, older age and living in a higher-income country ($p<.001$). Poorer sleep health was associated with a stricter level of quarantine, and other pandemic-related factors including being laid off from job, financial strain, or difficulties with transitioning to working from home ($R2=.116$, $p<.001$). Domestic conflict emerged as the strongest correlate of poorer sleep health in the regression model. Greater depression and anxiety symptoms were associated with a poorer sleep health ($p<.001$). In a global comparison, Latin Americans reported the lowest sleep health scores.
Conclusion: Our findings highlight how sleep behavior has changed during the international quarantine- and isolation measurements and show the association between pandemic-related factors and poor sleep health, which, in turn, is closely linked with poorer mental health. These results emphasize the importance of maintaining good sleep health during the pandemic, since poorer sleep health may trigger or exacerbate mental disorders. Maintenance of good sleep health should be incorporated into public health messages aimed at helping people maintain optimal mental and physical health during major stressful life events like the COVID-19 pandemic.
Support (if any):

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REFINING THE SUBJECTIVE ASSESSMENT OF SLEEP: AN SEM APPROACH

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Introduction: Given that sleep is multidimensional, the assessment of sleep requires an examination of a number of different domains. Accordingly, there is an abundance of self-report sleep questionnaires that are widely used for both research and clinical use. The surplus of available measures can be problematic, as it often leads to difficulties in selecting the best measure for a given purpose/context. In addition, the use of multiple measures to assess sleep may be an inefficient use of time and resources if they are not measuring unique constructs. The purpose of the current study is to evaluate the factor structure of five sleep measures. A confirmatory factor analysis (CFA) was initially used to evaluate whether each of these scales are measuring different factors of sleep, with follow-up exploratory factor analysis (EFA) as needed.
Methods: An archival analysis was performed using data from an online study, Investigating Sleep Across Normal Development (ISLAND Study). The sample consisted of 3,284 adults aged 18+. The following measures were utilized: RU SATED, PROMIS Sleep-Related Impairment, Sleep Self-Efficacy, Insomnia Severity Index, and the Sleep Regularity Questionnaire.
Results: As expected, the CFA model fit was determined to be poor and an EFA was then conducted to assess the factor structure of these scales. The EFA revealed a four-factor structure comprised of 25 items: Sleep-Related Daytime Impairment, Sleep Regularity, Sleep Disturbance, and Sleep-Related Daytime Enhancement.
Conclusion: The findings from the current study add to the literature supporting the multidimensionality of sleep, as well as the continued need to assess the various facets that comprise this construct. Although the literature supports the utility of these five measures, the present study found that within a community sample, these measures are not entirely unique. Further, the present study extends our knowledge and the literature by revealing a novel factor of sleep – Sleep-Related Daytime Enhancement. It may be worthwhile for researchers and clinicians to consider latent sleep factors that contribute to sleep disturbance and sleep health. Future work is needed to further confirm the observed factor structure and assess the psychometrics of this new scale.
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COVID-19 PANDEMIC NIGHTMARES AT THE US-MEXICO BORDER

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Introduction: The COVID-19 pandemic has impacted individuals in many ways, including anecdotal reports of nightmares. However, little data exists regarding the experience of COVID-related nightmares, especially among the distressed population at the US-Mexico Border. This is especially relevant given the clinical importance of nightmares as risk factors for poor mental health and sleep disturbances.

Methods: Participants were N=155 individuals who completed the Nogales Cardiometabolic Health and Sleep (NOCHES) and were contacted about completing a COVID sub-study (95% Hispanic/Latino). Participants were asked for the number of nightmares that they have experienced since the pandemic started. They were also asked whether they had nightmares about confinement, claustrophobia, suffocation, oppression, drowning, failure, helplessness, natural disasters, anxiety, evil forces, war, separation from loved ones, being chased, sickness, death, COVID, and apocalypse. They were also asked whether they experienced, due to the pandemic, increased general, financial, food, housing, familial, relationship, and media-related stress. Each of these items was coded from 0 ("Strongly Disagree") to 3 ("Strongly Agree"), with total scores ranging from 0-21. Regression analyses (linear for frequency and binary logistic for content) examined stress score as independent variable, adjusted for age, sex, financial status, education, and mental health (PHQ4).
Results: Those who experienced greater pandemic-related stress reported more nightmares (age/sex-adjusted B=0.23, p<0.0005, fully-adjusted B=0.23, p<0.0005). They were also more likely to have nightmares about confinement (adjusted odds ratio [OR]=1.69, p=0.008), suffocation (OR=1.41, p=0.020), failure (OR=1.23, p=0.049), being chased (OR=1.24, p=0.013), sickness (OR=1.26, p=0.022), and COVID (OR=1.37, p=0.003).
Conclusion: Those who experienced more pandemic-related stress reported more nightmares, even after adjusting for depression/anxiety symptoms. In addition, those with more pandemic-related stress were more likely to have nightmares about COVID itself, as well as confinement and suffocation, being chased, failure, and sickness in general. Perhaps efforts to reduce pandemic-related stress will reduce these nightmare experiences, which may have beneficial effects on other areas of mental health.
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COVID-19 PANDEMIC SLEEP AND DREAMS AT THE US-MEXICO BORDER

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Introduction: The impact of the COVID-19 pandemic in the border region is not well-described, including the impact of pandemic-related sleep disturbances on dream experiences, despite frequent reports of meaningful changes to dreams in the population.
Methods: Participants were 155 individuals who completed the Nogales Cardiometabolic Health and Sleep (NOCHES) Study and a COVID sub-study (95% Hispanic/Latino). Participants were asked whether, as a result of the pandemic, they have experienced more schedule regularity, improved/worsened sleep, more initial or middle-of-the-night insomnia, more sleepiness, and more napping. They were also asked whether they experienced more, fewer, or the same amount of dreams in general, positive dreams, and negative dreams. Multinomial logistic regressions were used to examine overall, positive, and negative dream recall (more or less vs same) as outcome and perceived change in sleep as independent variable, adjusted for age, sex, socioeconomics, and mental health symptoms (assessed with PHQ4).
Results: Those who reported more schedule regularity were less likely to report more negative dreams (Relative Risk Ratio [RRR]=0.40, p=0.010). Those who reported improved sleep were also more likely to report more positive dreams (RRR=3.97, p=0.004). Those with worsened sleep were more likely to report fewer dreams overall (RRR=2.23, p=0.037), fewer positive dreams (RRR=2.24, p=0.003) and more negative dreams (RRR=3.69, p<0.0005). Those with more initial insomnia were more likely to report fewer positive dreams (RRR=2.43, p=0.002) and more negative dreams (RRR=4.12, p<0.0005). Those with more middle-of-the-night insomnia reported fewer dreams overall (RRR=2.35, p=0.018), fewer positive dreams (RRR=2.55, p=0.001), and more negative dreams (RRR=5.01, p<0.0005). Those with more daytime sleepiness were more likely to report fewer dreams overall (RRR=4.75, p<0.0005), fewer positive dreams (RRR=1.92, p=0.019), and more negative dreams (RRR=3.91, p<0.0005), and were less likely to report more positive dreams (RRR=0.26, p=0.018). Those who reported napping more were more likely to report fewer dreams overall (RRR=2.78, p=0.008), fewer positive dreams (RRR=2.10, P=0.008), and more negative dreams (RRR=2.83, p=0.003), and were less likely to report more positive dreams (RRR=0.16, p=0.004).
Conclusion: Those whose sleep worsened due to the pandemic reported less dream recall, and dream content that was more negative and less positive overall.
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COVID-19 PANDEMIC SLEEP CHANGES RELATED TO SOCIAL AND FINANCIAL IMPACTS AT THE US-MEXICO BORDER

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Introduction: The COVID-19 pandemic has caused major impacts to social and financial status for many people, including those living in the vulnerable US-Mexico border region. This study examined relationships between changes in sleep and perceived impacts to social and financial stability due to the pandemic.
Methods: Participants were 155 individuals who completed the Nogales Cardiometabolic Health and Sleep (NOCHES) and were contacted about completing a COVID sub-study (95% Hispanic/Latino). Participants were asked if the COVID-19 pandemic was causing them to feel more socially isolated, negatively impacting their finances, causing increased worry about finances, affecting their primary job, causing a job loss, and impacting their belief life will one day return to normal. In addition, they were asked to report the degree to which they experienced pandemic-related changes to sleep, including a regularity, overall improvement/worsening, initial and middle-of-the-night insomnia, daytime sleepiness, and napping. Logistic regression analyses were adjusted for age, sex, socioeconomics, and mental health (PHQ4).
Results: Those who kept a more regular schedule had lower odds of endorsing isolation (OR=0.32,p<0.0005) and higher odds of believing things will return to normal (OR=1.67,p=0.041). Those whose sleep improved also had lower odds of feeling isolated (OR=0.40,p=0.005). Those with worsened sleep had increased odds of feeling isolated (OR=2.14,p=0.023), experiencing a financial impact (OR=1.85,p=0.016) and increased financial worry (OR=1.71,p=0.033), and lower odds of believing things will return to normal (OR=0.53,p=0.012). More initial insomnia was associated with isolation (OR=3.62,p=0.001), financial impact, (OR=1.89,p=0.015), financial worry (OR=1.87,p=0.016) and job impact (OR=1.95,p=0.010). More middle-of-the-night insomnia was associated with financial worry (OR=1.82,p=0.016) and job impact (OR=1.93,p=0.009). More

sleepiness was associated with job loss (OR=1.84,p=0.043). More napping was associated with financial impact (OR=1.89,p=0.017) and worry (OR=1.88,p=0.017), impact to job (OR=1.89,p=0.016) or lost job (OR=1.81,p=0.041), and decreased likelihood of believing things will return to normal (OR=0.45,p=0.003).
Conclusion: Pandemic-related stress was linked with sleep disturbances. Worse sleep was indicative of increased social isolation, greater financial fears, more job-related impacts and less of a general sense that things would return to normal.
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COVID-19 PANDEMIC SLEEP DISTURBANCES RELATED TO STRESS EXPERIENCES AT THE US-MEXICO BORDER

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Introduction: The COVID-19 pandemic has impacted many individuals at the vulnerable US-Mexico border region in a variety of ways. Fear, worry, and stress have increased for many, as has poor sleep. The present study evaluated the degree to which worsened sleep due to the pandemic impacted stress experiences.
Methods: Participants were N=155 individuals who completed the Nogales Cardiometabolic Health and Sleep (NOCHES) and were contacted about completing a COVID sub-study (95% Hispanic/Latino). They were asked the degree to which their sleep worsened due to the pandemic. They also reported the degree to which they agreed with statements regarding various pandemic-related stress experiences. These included infection-related stresses, stresses about community impact, personal psychosocial stresses, stresses about consequences of potential infection, media and society-related stresses, feelings of safety, and how the pandemic has impacted home life. Ordinal logistic regressions were used to determine whether changes in sleep were associated with agreement with statements about pandemic-related stress experiences, adjusted for age, sex, financial status, education, and mental health (PHQ4).
Results: Those who perceived that their sleep worsened were more likely to report greater endorsement of beliefs that they were infected (ordinal Odds Ratio [oOR]=2.82,p<0.0005), they could possibly be infected (oOR=1.98,p=0.003), they feared testing (oOR=1.94,p=0.006), COVID-19 would impact their community (oOR=1.75,p=0.017) and would do so for a long time (oOR=1.90,p=0.006), they experience more general (oOR=4.10,p<0.0005), financial (oOR=3.15,p<0.0005), food-related (oOR=2.97,p<0.0005), housing-related (oOR=2.14,p=0.002), family-related (oOR=2.53,p<0.0005) and relationship (oOR=3.37,p<0.0005) stress, their shopping was impacted by scarcity (oOR=1.76,p=0.014), and they are at high risk for COVID (oOR=1.87,p=0.008). Furthermore, media coverage of COVID-19 had increased their stress (oOR=2.46,p<0.0005), there is too much panic about COVID-19 (oOR=1.67,p=0.032), and they themselves are scared of getting COVID-19 (oOR=1.95,p=0.005), worried about the future (oOR=1.71,p=0.022), feel less secure (oOR=0.59,p=0.028), are thriving less (oOR=0.40,p<0.0005), and their mental health is not improving (oOR=0.46,p=0.002).
Conclusion: Worse sleep due to the COVID-19 pandemic was associated with increased reports of stresses across a wide range of domains. Perhaps sleep health interventions could improve social and emotional health in these domains and reduce stress experiences and better cope with the pandemic. Alternatively, mental health interventions should perhaps be targeted to this population.
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COVID-19 PANDEMIC SLEEP DISTURBANCES RELATED TO DIETARY BEHAVIOR AT THE US-MEXICO BORDER

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Introduction: The COVID-19 pandemic has disrupted life at the US-Mexico border in many ways, including sleep and dietary behavior. Given the potential long-term impact of worsening sleep and metabolic health due to the pandemic, the present study examines whether changes to dietary behavior were associated with changes to sleep.
Methods: Participants were 155 individuals who completed the Nogales Cardiometabolic Health and Sleep (NOCHES) Study and were contacted about completing a COVID-19 sub-study (95% Hispanic/Latino). Participants reported the degree to which they experienced pandemic-related changes to sleep, including a more regular schedule, overall improvement, overall worsening, more initial insomnia, more middle-of-the-night insomnia, more daytime sleepiness, and more napping. They were also asked whether as a result of the pandemic they consumed an overall healthier diet, more homecooked meals, more processed meals, more regular meals, whether they enjoyed food more, and degree of overeating. Ordinal regressions with diet change as outcome and sleep change as predictor were adjusted for age, sex, education, and socioeconomics.
Results: Those who reported more regular sleep were more likely to report a healthier overall diet (oOR=3.12,p<0.0005), more homecooked meals (oOR=2.18,p=0.001), more enjoyment of food (oOR=1.71,p=0.028), and less likelihood of overeating (oOR=0.59,p=0.033). Similarly, those who reported more "improved" sleep reported healthier overall diet (oOR=7.42,p<0.0005), more homecooked meals (oOR=2.59,p=0.001), more regular diet (oOR=2.15,p=0.006), more enjoyment of food (oOR=2.92,p<0.0005), less consumption of processed foods (oOR=0.54,p=0.039), and less overeating (0.33,p<0.0005). Those whose sleep worsened reported eating more processed foods (oOR=1.78,p=0.030) and overeating (oOR=3.90,p<0.0005). Those who reported more initial insomnia reported eating more processed foods (oOR=1.93,p=0.016), more regular diet (oOR=1.65,p=0.042), and overeating more often (oOR=4.11,p<0.0005). More middle-of-the-night insomnia was associated with eating more processed foods (oOR=2.45,p=0.001), more regular diet (oOR=1.66,p=0.031), and overeating more often (oOR=3.68, <0.0005). Those with more daytime sleepiness also reported eating more processed foods (oOR=2.36,p=0.003), more regular diet (oOR=1.79, =0.019), and overeating more often (oOR=3.28,p<0.0005). More napping was associated with a more regular diet (oOR=1.90,p=0.011) and more overeating (oOR=3.53,p<0.0005).
Conclusion: Overall, worse sleep led to worse dietary behavior, especially eating more processed food and overeating.
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CHANGING SLEEP DURING THE COVID PANDEMIC ASSOCIATED WITH DAYTIME COGNITIVE FUNCTION

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Introduction: The novel Coronavirus has caused major disruptions to sleep and cognitive function of many individuals. The present study evaluated the degree to which daytime cognitive dysfunction may be related to worsening sleep.
Methods: Data from adults aged 18 and older in the 2020 Coronavirus and Impact on Dreams (CovID) study were used. Individuals were asked "how would you rate your sleep quality overall" and answered with "very good, fairly good, fairly bad, or very bad." Subjects were asked if it takes "30 minutes or more to fall asleep" and answered with how frequently that happened. In addition, participants were asked how often they wake up during the night. Participants were then asked how much they think their sleep problems have contributed to daytime functioning and answered on a scale of 0 to 5, from "not at all" to "very much," respectively.
Results: 46% of the sample did not report problems with daytime cognitive function, while 33%, 12%, and 9% reported mild, moderate, and severe problems, respectively. Those who reported that they have kept a regular schedule during the pandemic were 83% less likely to report greater daytime cognitive dysfunction (95%CI:0.08,0.37, p<0.0005). Those who indicated that overall their sleep worsened or improved did not demonstrate a difference in likelihood of daytime cognitive problems. Regarding specific sleep experiences, those who reported more problems falling asleep due to the pandemic were 8.2 times more likely to report daytime cognitive dysfunction (95%CI:3.53,19.07, p<0.0005) and those who reported more problems with morning awakenings were 5.7 times more likely (95%CI:2.10,15.56, p<0.001). Those who reported that they were sleepier as a result of the pandemic were 9.3 times as likely to report daytime cognitive dysfunction (95%CI:3.53,24.46, p<0.0005) and those who reported taking more naps were 4.4 times more likely (95%CI:1.90,10.40, p<0.001).
Conclusion: In general, people who reported increased sleepiness, a less regular schedule, more insomnia, and more napping were more likely to experience daytime cognitive dysfunction during the COVID-19 pandemic.
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CHANGES IN PHYSICAL ACTIVITY DURING THE COVID-19 PANDEMIC ASSOCIATED WITH CHANGES IN SLEEP

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Introduction: The COVID-19 global pandemic has likely led to changes in physical activity as behavioral patterns were disrupted. This is important because sleep and physical activity are interrelated and promote health, and well-being. This study examined whether changes to physical activity were related to changes to sleep health as a result of the COVID-19 pandemic.
Methods: A sample of N=419 US adults completed online surveys about sleep and COVID-19 experiences. Participants were asked to estimate the number of minutes per day they engaged in physical activity during the pandemic, as well as before. These were subtracted from each other, and a difference score was computed. Then, responses were categorized as no change (<=15 mins difference), 16-45 minutes more or less activity, or 46+ minutes more or less activity (5 categories total). Outcome variables included the degree to which participants believed that due to the pandemic, they experienced (1) more schedule regularity, (2) better sleep, (3) worse sleep, (4) more difficulty falling asleep, (5) more difficulty maintaining sleep, (6) more sleepiness, and (7) more napping. Ordinal regressions were adjusted for age, and sex.
Results: Those who increased their activity by over 45 minutes per day reported that they were less likely to experience more daytime sleepiness (oOR=0.28, p<0.02). Those who decreased their activity by over 45 minutes per day reported that they were more likely to experience worse sleep (oOR=2.38, p<0.01) and less likely to experience a more regular schedule (oOR=0.37, p<0.003) than prior to the pandemic.
Conclusion: Overall, those who increased their physical activity since the beginning of the pandemic reported less daytime sleepiness; and those who decreased their physical activity reported worse sleep experiences and a more irregular schedule. The relationship between physical activity and sleep during the pandemic may be bidirectional.
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CHANGES IN SLEEP DUE TO COVID PANDEMIC ASSOCIATED WITH CHANGES TO DIETARY PATTERNS

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Introduction: The COVID-19 pandemic has affected sleep and diet for many people. The present study sought to examine potential associations between changes to sleep and eating habits during the COVID-19 pandemic.
Methods: A sample of N=419 US adults completed online surveys about sleep and COVID-19 experiences. Questions for diet asked, "since quarantine: I'm eating healthier, eating more processed foods, home-cooked meals and more regularly," "I'm enjoying food in quarantine and I'm struggling with overeating in quarantine." Sleep questions asked "since quarantine: I have managed to keep a regular sleep-wake schedule, my sleep has improved, I'm struggling to fall asleep, I'm waking up more during the night, I'm more sleepy during the day and I'm taking more naps during the day." Answers were reported on a 4-point scale ranging from "strongly disagree to strongly agree." Ordinal logistic regressions were used, adjusted for age and sex and examined each dietary variable as ordinal outcome and each sleep variable as predictor.
Results: Those who report that they kept a more regular schedule were more likely to report eating healthier (oOR=3.13, p=0.007), eating more home-cooked meals (oOR=3.19, p=0.005), and less likely to be eating more processed foods (oOR=0.39, p=0.02), struggle with overeating (oOR=0.39, p=0.02) or undereating (oOR=0.30, p=0.004) or snacking (oOR=0.25, p=0.001). Those reporting more difficulty falling asleep were less likely to be eating healthier (oOR=0.25, p=0.002) and more likely to be eating more processed foods (oOR=3.07, p=0.009) and snacking (oOr=2.36, P=0.04). Those reporting more difficulty with awakenings were less likely to report eating healthier (oOR=0.34, p=0.03) and more likely to report eating more processed foods (oOR=4.52, p=0.001). Those with more sleepiness were less likely to report eating healthier (oOR=0.29, p=0.01) and more homecooked meals (oOR=0.40, p=0.046) and more likely to report eating more processed foods (oOR=6.42, p<0.0005), overeating (oOR=3.63, p=0.01) and snacking (oOR=5.81, p=0.001).
Conclusion: Research studying psychological, behavioral and environmental factors that are contributing to changes in sleep and dietary patterns is especially important during a pandemic that has forced people into changes that they may not have been prepared for and which may result in long-term health outcomes.
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CHANGES IN SLEEP DUE TO THE COVID PANDEMIC ASSOCIATED WITH SLEEP ENVIRONMENT

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Introduction: The COVID-19 pandemic has resulted in adverse impacts on sleep for many people. The physical environment has been a focus for health-related behaviors during the pandemic since movement restrictions have led to a heightened awareness of the living environment. This study examined whether those whose physical environment was more disruptive to sleep systematically experienced more pandemic-related sleep problems.
Methods: A sample of N=419 US adults completed online surveys (mostly during the summer months) about sleep and COVID-19 experiences. Participants were asked the degree to which they endorsed statements that due to the pandemic, (1) they were able to keep a regular schedule, (2) they had more problems falling asleep, (3) they had more problems with nighttime awakenings, (4) they experienced more daytime sleepiness, and (5) they napped more. Sleep environment was assessed using the Assessment of Sleep Environment (ASE), a 13-item questionnaire that quantifies the degree to which sleep is disrupted environmental influences (scores range from 0-39). Ordinal logistic regression analyses, with degree of agreement with statements about changing sleep due to the pandemic as outcome, ASE score as independent variable, and age and sex as covariates.
Results: Worse sleep environment was associated with a decreased likelihood of being able to keep a regular schedule (oOR=0.96, p<0.04) and an increased likelihood of more problems falling asleep (oOR=1.04, p<0.02), problems with nighttime awakenings (oOR=1.03, p<0.02), daytime sleepiness (oOR=1.03, p<0.03), and napping (oOR=1.03, p<0.04). Post-hoc analyses examine contributions of individual items, and the one that was independently most associated with changes in sleep was sleeping environment being too warm.
Conclusion: Those with a more disruptive sleep environment experienced a greater degree of problematic sleep problems as a result of the COVID-19 pandemic. The fact that these assessments largely took place in warmer months may explain why sleeping environments being "too warm" was especially salient.
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SOCIODEMOGRAPHIC, BEHAVIORAL, AND HEALTH-RELATED FACTORS ASSOCIATED WITH SLEEP AMONG NATIVE HAWAIIANS AND OTHER PACIFIC ISLANDERS

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Introduction: Previous studies have suggested that Native Hawaiians/Pacific Islanders show different associations between sleep and health risks, compared to other groups. The present study evaluated sleep and health risk factors in a nationally-representative sample.
Methods: Data from the Native Hawaiian and Pacific Islander National Health Interview Survey (NHPI-NHIS), collected by the CDC in 2013, was used for analysis. A total of N=2,124 individuals provided complete data on all variables. Sleep outcomes included hours of sleep (3-12h), days/week difficulty falling asleep, difficulty maintaining sleep, and nonrestorative sleep (ordinal). Weighted regression analyses (linear or ordinal logistic) evaluated whether sleep outcomes were associated with cancer, diabetes, hypertension, stroke, obesity, poor health, depression, anxiety, smoking, alcohol, activity, functional limitations, foregoing medical care due to cost, frequent healthcare utilization, health insurance, and difficulty paying medical bills, in models that also included age, sex, immigrant status, multiracial status, education, employment, income, and relationship status.
Results: Shorter sleep was associated with older age, earning <$20,000, and being divorced/widowed/separated, and longer sleep was associated with being female and less than high school education. Shorter sleep was also associated with fair health and current drinking. Difficulty falling asleep was positively associated with older age, earning <=$44,999, being divorced/widowed/separated, obesity, worse health, depressed mood, anxiety, daily smoking, former and current drinking, functional limitations, foregoing care, frequent care, and difficulty with bills. Difficulty falling asleep was negatively associated with immigrant status and being retired. Difficulty maintaining sleep was associated with older age, being unmarried but partnered, obesity, worse health, depression, anxiety, daily smoking, current or heavy drinking, being inactive, functional limitations, foregoing care, frequent care, and difficulty with medical bills. Nonrestorative sleep was associated with non-immigrant status, employment, being a homemaker, disability, being unmarried, obesity, worse health, depression, anxiety, daily smoking, former, current, or heavy drinking, inactivity, functional limitations, foregoing care, frequent care, and difficulty with medical bills.
Conclusion: Short sleep was not significantly associated with common health risk factors seen in other groups. Sleep difficulties, though, were related to a constellation of sociodemographic, socioeconomic, behavioral, and cardiometabolic risks. Further research regarding insomnia as a health risk factor in this population is warranted.
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SLEEP DISTURBANCES DURING THE COVID-19 PANDEMIC ASSOCIATED WITH WORRIES AND FEARS ABOUT POSSIBLE INFECTION

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Introduction: The sudden COVID-19 pandemic and the uncertainty surrounding the virus has led to increased worry and fear. How this fear is associated with sleep remains unknown.
Methods: 419 US adults completed online surveys about sleep and COVID-19 experiences. Participants were asked about agreement with statements endorsing beliefs that they were currently infected, that they would someday be infected, that they fear testing, and that they are worried about a family member becoming infected. They were asked to rate agreement with statements regarding changes to sleep during the pandemic. Ordinal logistic regressions with degree of agreement with statements about sleep changes were outcomes, agreement with statements about COVID infection beliefs as predictor, and age, sex, and race/ethnicity as covariates were examined.
Results: Those who believed they were infected were 65% less likely to be keeping a regular schedule (p=0.001), 61% less likely to report improved sleep (p=0.009), 2.9 times as likely to report worse sleep (p=0.001), 2.7 times as likely to report difficulty falling asleep (p=0.002), 2.1 times as likely to report sleep maintenance problems (p=0.03), 2.9 times as likely to report sleepiness (p=0.001). Those who believed they would be infected in the future were 83% less likely to report improved sleep (p=0.005), 7.49 times as likely to report worse sleep (p=0.001), 5.3 times as likely to report difficulty falling asleep

(p=0.003), 4.1 times as likely to report sleep maintenance problems (p=0.01), and 5.7 times as likely to report sleepiness (0.003). Those that feared testing were 5.7 times as likely to report more sleepiness (p=0.03). Those that worried about family were 80% less likely to be keeping a regular schedule (p=0.01), 75% less likely to report improved sleep (p=0.02), 4.5 times as likely to report worse sleep (p=0.02), 4.5 times as likely to report sleep maintenance problems (p=0.01), and 8.3 times as likely to report sleepiness (p=0.001).

Conclusion: Those who believed they were infected reported worsening sleep, though the degree was even greater among those who anticipated infection for themselves or a family member. Worries about COVID-19 may result in more adverse impact on sleep than potential infection itself.

Support (if any):

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NIGHTMARE CONTENT DURING THE COVID-19 PANDEMIC: INFLUENCE OF COVID-RELATED STRESS AND SLEEP DISRUPTION

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Introduction: Nightmares are often associated with psychiatric disorders, though acute stress can also induce them. This study explores how the COVID-19 pandemic may have influenced the frequency and content of nightmares.

Methods: A sample of N=419 US adults completed online surveys about sleep and COVID-19 experiences. Participants were asked the degree to which they agree with statements including that due to the COVID-19 pandemic, they have greater general stress, worse overall sleep, and more middle-of-the-night insomnia. They were also asked if they experienced nightmares during the pandemic on a range of topics, including confinement, claustrophobia, suffocation, oppression, drowning, failure, helplessness, natural disasters, anxiety, evil forces, war, domestic abuse, separation from loved ones, totalitarian regimes, being chased, dangerous animals, sickness, death, COVID-19, and apocalypse. Logistic regression analyses examined each nightmare content as outcome and increased stress, worse sleep, and more middle-of-the-night insomnia as predictors, adjusted for age, sex, and race/ethnicity.

Results: Those who reported greater general COVID-related stress were more likely to have nightmares about confinement (OR=1.66,p<0.03), failure (OR=1.64,p<0.005), helplessness (OR=2.89, 0<0.0005), anxiety (OR=2.37,p<0.0005), war (OR=3.42,p<0.0005), separation (OR=2.23,p<0.0005), totalitarianism (OR=3.78,p<0.003), sickness (OR=1.92,p<0.003), death (OR=1.66,p<0.01), COVID (OR=1.96,p<0.01), and apocalypse (OR=2.92,p<0.0005). Those who reported worsened sleep were more likely to have nightmares about confinement (OR=1.80,p<0.003), oppression (OR=2.99,p<0.0005), failure (OR=2.12,p<0.0005), helplessness (OR=1.67, 0<0.0005), disaster (OR=1.86,p<0.005), anxiety (OR=1.97,p<0.0005), evil forces (OR=1.56,p<0.02), war (OR=2.08,p<0.002), domestic abuse (OR=2.22,p<0.009), separation (OR=2.01,p<0.0005), totalitarianism (OR=3.39,p<0.0005), sickness (OR=1.74,p=0.003), death (OR=2.03,p<0.0005), COVID (OR=2.15,p<0.001), and apocalypse (OR=1.86,p<0.006). Those who reported worsened middle-of-the-night insomnia were more likely to have nightmares about confinement (OR=1.60,p<0.01), oppression (OR=1.97,p<0.002), failure (OR=2.00,p<0.0005), helplessness (OR=1.60,p<0.001), disaster (OR=1.52,p<0.04), anxiety (OR=2.27,p<0.0005), war (OR=2.10,p<0.001), domestic abuse (OR=1.74,p<0.04), separation (OR=1.86,p<0.0005), totalitarianism (OR=1.87,p<0.03), sickness (OR=1.80,p<0.001), death (OR=2.00,p<0.0005), COVID (OR=1.68,p<0.009), and apocalypse (OR=1.65,p<0.01).

Conclusion: The results suggest that increased stress may induce negatively-toned dreams related to that stress. Future studies will have to determine whether (and when) this symptom indicates an emotional regulation mechanism at play or the failure of such a mechanism.

Support (if any):

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CHANGES IN DREAM RECALL DURING THE COVID-19 PANDEMIC: ASSOCIATIONS WITH SLEEP, STRESS AND DREAM CONTENT

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Introduction: During the COVID-19 pandemic, individuals have faced unprecedented events, which are often stressful. Stress has an important impact on dreams, and stress-induced sleep difficulties may also impact dream recall. The present study evaluated associations between sleep, stress and dream content on dream recall during the pandemic.

Methods: A sample of N=419 US adults completed online surveys about sleep and COVID-19 experiences. Participants were asked if they remember more, fewer or about the same amount of dreams as before the pandemic. They were also asked whether the pandemic was associated with more stress, a more regular schedule, improved sleep, worse sleep, more early insomnia, more middle-of-the-night insomnia, more sleepiness, and more naps. They also completed the Insomnia Severity Index, Fatigue Severity Scale, Epworth Sleepiness Scale, Brief Index of Sleep Control, Assessment of Sleep Environment, GAD-7 anxiety scale, and PHQ9 depression scale. Multinomial logistic regressions examined correlates of increased or decreased recall (versus same), adjusted for age, sex, and race/ethnicity.

Results: Those who experienced greater schedule regularity were less likely to report decreased recall (RRR=0.50,p<0.0005), as were those who reported sleep improvement (RRR=0.48,p=0.006). Those whose sleep worsened were more likely to report both increased (RRR=1.64,p=0.003) and decreased (RRR=2.16,p<0.0005) recall. Those suffering maintenance insomnia were more likely to report both increased (RRR=1.70,p=0.001) and decreased (RRR=2.68,p<0.0005) recall, as did those who reported more daytime sleepiness (Increased RRR=1.57,p=0.006; Decreased RRR=1.94,p=0.001). Those whose dream content was more negative were more likely to report both increased (RRR=4.05,p<0.005) and decreased (RRR=3.35,p<0.0005) recall, as did those who reported less negative content (Increased RRR=4.20,p<0.0005; Decreased RRR=5.05,p<0.0005). Similarly, those who reported more positive dream content reported both increased (RRR=17.37,p<0.0005) and decreased (RRR=7.14,p=0.02) recall, as did those who reported less positive content (Increased RRR=4.49,p<0.0005; Decreased RRR=5.59,p<0.0005). Less recall was associated with greater insomnia severity (RRR=1.08,p=0.001), fatigue (RRR=1.04,p=0.001), sleepiness (RRR=1.09,p=0.01), COVID stress (RRR=1.67,p=0.03), anxiety (RRR=1.08,p=0.01), and depression (RRR=1.06,p=0.007), worse sleep environment (RRR=1.06,p=0.005), and less sleep control (RRR=0.56,p=0.001).

Conclusion:: The results of this survey suggest that a sudden decrease in dream recall in reaction to a new stress could be considered as a pejorative indicator regarding sleep quality and mental health.

Support (if any): R01MD011600, R01DA051321

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PANDEMIC-RELATED SLEEP CHANGES ASSOCIATED WITH COVID-RELATED GENERAL, FINANCIAL, FOOD, HOUSING, FAMILY AND RELATIONSHIP STRESS

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Introduction: The COVID-19 pandemic has caused widespread disruption and stress for people of all ages and circumstances around the world. This study investigates the relationship between general and specific stressors and various dimensions of sleep health.
Methods: A sample of N=419 US adults completed online surveys about sleep and COVID-19 experiences. Participants were asked whether they experienced increased general, financial, food, housing, family and relationship stress due to the COVID-19 pandemic. They were also asked whether they experienced a more regular schedule, improved sleep, worsened sleep, more early insomnia, more middle-of-the-night insomnia, more daytime sleepiness, and more naps due to the COVID-19 pandemic. Ordinal logistic regressions with sleep change as outcome and stress variable as predictor were adjusted for age, sex, and race/ethnicity.
Results: COVID-19-related general, financial, food, housing, family, and relationship stress were all associated with a decreased likelihood of maintaining a more regular schedule (oOR=0.52-0.67, all p<0.001) and improved sleep (oOR=0.56-0.67, all p<0.001). They were also all associated with a greater likelihood of worsened sleep (oOR=1.48-2.41, all p<0.001), early insomnia (oOR=1.63-1.85, all p<0.001), middle-of-the-night insomnia (oOR=1.40-2.00, all p<0.001), and daytime sleepiness (oOR=1.58-2.07, all p<0.001). Increased napping was also associated with more COVID-related financial, food, and housing stress (oOR=1.33-1.55, all p<0.005).
Conclusion: Regular sleep schedules can be disrupted by stressors directly, or by the anxiety that so often accompanies stress. Stressed individuals may experience increased difficulty falling asleep, or more nighttime arousals, or find themselves waking up earlier than usual, all as a result of ruminating thoughts, stress-induced nightmares, or outside disturbances. Disruption to sleep at night often results in increased daytime sleepiness and fatigue, with a higher chance of napping. This study reports the significant association of some of these with COVID-19 pandemic-related stress. More individuals now find themselves working from home with greater flexibility in their schedules, but this has not necessarily led to better sleep. The impact of the pandemic on various health outcomes as a result of stress is still to be revealed.
Support (if any):

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AN ELECTION DURING A PANDEMIC: RELATIONSHIP BETWEEN POLITICAL AFFILIATION AND PANDEMIC-RELATED SLEEP AND DREAMS

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Introduction: In 2020, a global pandemic impacted sleep for many people in the US, which was also experiencing an extremely contentious election season. These overlapped somewhat, as the liberal/left side of the political spectrum was more vocal about the dangers of COVID-19 and the pandemic, while the conservative/right frequently expressed less concern about COVID-related risks. Perhaps this confluence was borne out in sleep quality and dreams.
Methods: A sample of N=419 US adults completed online surveys about sleep and COVID-19 experiences. Participants rated their political affiliation on a scale of 0 (Very Conservative/Right) to 6 (Very Liberal/Left). Participants were also asked whether, since the pandemic, their sleep improved or worsened, whether their dream content has become more positive (more or less positive content, versus same) or negative (more or less negative content, versus same), the number of nightmares they recall, and whether their dreams included themes of politics and/or COVID. Regression analyses examined political affiliation as independent variable with ordinal logistic analyses for sleep improvement/worsening, multinomial logistic analyses for positive/negative content, linear regression analyses for nightmare frequency, and binary logistic analyses for presence of political/COVID themes in dreams. All analyses were adjusted for age, sex, and race/ethnicity.
Results: Greater liberal/left affiliation was associated with a greater likelihood of worsened sleep (oOR=1.20, p=0.002), but no difference in likelihood of sleep improvement. Greater liberal/left affiliation was associated with a greater likelihood of decreased positive dream content (RRR=1.29, p=0.001) but no different in likelihood of increased positive content. In addition, greater liberal/left affiliation was associated with an increased likelihood of more negative dream content (RRR=1.33, p<0.0005) but no difference in the experience of less negative content. Liberal/left affiliation was also associated with more frequent nightmares during the pandemic (B=1.55, p=0.019), and more political dreams (OR=1.29, p=0.010) but no difference in COVID-related dreams.
Conclusion: During the COVID-19 pandemic, more liberal/left individuals reported a greater degree of worsening sleep and dream content that was less positive and more negative in nature. Though there was no difference in COVID-related dream content, there was a difference in political content in dreams.
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EATING PATTERNS ASSOCIATED WITH SLEEP DURATION, INSOMNIA, DAYTIME SLEEPINESS AND OVERALL SLEEP QUALITY AT THE US-MEXICO BORDER

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Introduction: Previous studies have linked sleep to risk of diabetes and obesity, at least partially via alterations in food intake. Diabetes and obesity are common among Hispanics/Latinos, and studies are needed to better clarify the role of sleep for health among this group.
Methods: Data were collected from N=100 adults (age 18-60, 47% female) of Mexican descent in the city of Nogales, AZ (34% not born in the US). Surveys were presented in English or Spanish. Eating Patterns were assessed with the Three-Factor Eating Questionnaire (TFEQ), which resulted in a total score and subscales for "cognitive restraint," "uncontrolled eating, "and "emotional eating." Insomnia was assessed with the use of the Insomnia Severity Index (ISI), Sleepiness with the use of the Epworth Sleepiness Scale (ESS), Sleep quality with the use of the Pittsburgh Sleep Quality Index (PSQI), and weekday and weekend sleep duration with the use of the Sleep Timing Questionnaire (STQ). Covariates included: age, sex, Body Mass Index (BMI), education and immigrant status.
Results: When adjusted for age, sex and immigrant status (model-1), eating patterns were associated with greater insomnia (95%CI:[0.066,1.095];p=0.027), poorer sleep

quality (95%CI:[0.170,1.456];p=0.014), sleepiness (95%CI[0.032,1.026];p=0.037), and weekend (but not weekday) sleep duration (95%CI:[-0.031,0.003];p=0.015). Further adjustment for education (model-2) revealed similar significant associations. Additional adjustment for BMI (model-3) revealed a change in daytime sleepiness, where no association was seen (95%CI:[-0.202,0.805];p=0.238). Regarding subscale scores, relationships were generally seen between sleep and both emotional eating and uncontrolled eating, but not cognitive restraint. However, after adjustment for BMI, there was a significant association between cognitive restraint and weekend sleep duration (95%CI:[-0.015,-0.001];p=0.030).

Conclusion: Greater insomnia, poorer sleep quality, increased daytime sleepiness and decreased weekend sleep duration were associated with eating patterns at the US Mexico border, particularly in terms of uncontrolled eating and emotional eating. This suggests possible mechanisms linking sleep and obesity in Hispanic/Latinos.

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LONGITUDINAL CHANGES IN SLEEP DURATION, TIMING, VARIABILITY, AND STAGES DURING THE COVID-19 PANDEMIC: LARGE-SCALE FITBIT DATA

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Introduction: The COVID-19 pandemic has resulted in societal-level changes to sleep and other behavioral patterns. Objective, longitudinal data would allow for a greater understanding of sleep-related changes at the population level.

Methods: N= 163,524 deidentified active Fitbit users from 6 major US cities contributed data, representing areas particularly hard-hit by the pandemic (Chicago, Houston, Los Angeles, New York, San Francisco, and Miami). Sleep variables extracted include nightly and weekly mean sleep duration and bedtime, variability (standard deviation) of sleep duration and bedtime, and estimated arousals and sleep stages. Deviation from similar timeframes in 2019 were examined. All analyses were performed in Python.

Results: These data detail how sleep duration and timing changed longitudinally, stratified by age group and gender, relative to previous years' data. Overall, 2020 represented a significant departure for all age groups and both men and women (P<0.00001). Mean sleep duration increased in nearly all groups (P<0.00001) by 5-11 minutes, compared to a mean decrease of 5-8 minutes seen over the same period in 2019. Categorically, sleep duration increased for some and decreased for others, but more extended than restricted. Sleep phase shifted later for nearly all groups (p<0.00001). Categorically, bedtime was delayed for some and advanced for others, though more delayed than advanced. Duration and bedtime variability decreased, owing largely to decreased weekday-weekend differences. WASO increased, REM% increased, and Deep% decreased. Additional analyses show stratified, longitudinal changes to sleep duration and timing mean and variability distributions by month, as well as effect sizes and correlations to other outcomes.

Conclusion: The pandemic was associated with increased sleep duration on average, in contrast to 2019 when sleep decreased. The increase was most profound among younger adults, especially women. The youngest adults also experienced the greatest bedtime delay, in line with extensive school-start-times and chronotype data. When given the opportunity, the difference between weekdays and weekends became smaller, with occupational implications. Sleep staging data showed that slightly extending sleep minimally impacted deep sleep but resulted in a proportional increase in REM. Wakefulness during the night also increased, suggesting increased arousal despite greater sleep duration.

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SLEEP DURATION, QUALITY AND TIMING DURING CONFINEMENT AMID THE COVID-19 PANDEMIC

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Introduction: As of March 2020, most U.S. states and territories issued statements advising people "stay at home" to avoid spreading the novel Coronavirus (COVID-19). This resulted in an unprecedented number of people practicing physical confinement and social distancing. This study examined self-reported changes in sleep duration, quality and timing in response to confinement and isolation.

Methods: We developed the "Anonymous Survey on Confinement during the COVID-19 Pandemic" to collect information on the American population practicing social distancing and some level of confinement. The survey collected information on demographics, duration and degree of confinement, and sleep-wake dynamics. The online survey was available for completion by any individual ≥18 years of age through the Penn Medicine Clinical Research page from May 16th to November 11th 2020. Descriptive statistics characterized the nature of confinement and non-parametric correlations evaluated the relationships between confinement and sleep-wake dynamics.

Results: N=226 participants completed the survey (n=176 female [77.8%]; n=47 male [20.8%]). The average age was 44.9±17.4 years. N=215[95.1%] reported confinement since March 2020 for an average of 89.3±41.7 days in confinement. Surveyed participants in confinement reported sleeping more than before confinement [40.0%], taking the same amount of time to fall asleep [56.6%], and felt that they were getting enough sleep [66.3%]. However, 36.3% of participants reported going to bed earlier and waking up earlier. Participants that engaged in naps prior to confinement reported taking more naps in confinement [50.8%]. Participants reported more daytime sleepiness [42.9%] and more disturbed sleep quality during confinement relative to before confinement [42.5%]. There were no significant correlations between time in confinement and sleep outcomes.

Conclusion: During the confinement amid the COVID-19 pandemic, participants responded by sleeping more and at different times, which could reflect circadian disruption of sleep. Changes in sleep amount and sleeping timing were accompanied by increased daytime sleepiness and a reduction in sleep quality. These changes may have been due to age, stressors experienced during the pandemic, social isolation, and/or a change in behavioral routines in response to changing demands and schedules. Our findings suggest that attention to changes in sleep-wake dynamics due to prolonged confinement is likely important to maintain healthy behaviors.

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RESILIENCE, SLEEP DIFFICULTIES, AND SUBJECTIVE SLEEP QUALITY DURING COVID-19

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Introduction: We have shown in a previous study that despite significant improvements in sleep patterns and sleep duration during COVID-19 in teens and young adults, only teens reported better sleep quality and satisfaction. Moreover, sleep difficulties seem to be more prominent in the older group during the pandemic, suggesting that there could be additional

risk factors involved. The current study aimed to investigate the role of resilience in the association between changes in sleep and the subjective sleep quality (SSQ) in teens and young adults during COVID-19.
Methods: 289 teens (12-17 years old) and 294 young adults (18-25 years old) completed the Connor-Davidson Resilience Scale-10 and an adapted version of the Pittsburgh Sleep Quality Index online. Teens and young adults were each divided into a resilient and less resilient group. Hierarchical regression models were conducted to examine the unique contribution of weekdays sleep duration, sleep difficulties, and resilience to SSQ. Sleep duration, sleep difficulties and SSQ before COVID-19, and gender were entered as controls.
Results: Results show that in less resilient teens, changes in sleep onset difficulties (β=-.285, p=.003), nocturnal and early awakenings (β=-.218, p=.019), and weekdays sleep duration (β=.282, p=.001) significantly predicted SSQ and explained 36.5% of the variance. In less resilient young adults, changes in nightmares (β=-.309, p=.027) and sleep onset difficulties (β=-.263, p=.012) significantly predicted SSQ and explained 24.1% of the variance. In resilient teens, changes in weekdays sleep duration (β=.296, p=.007) significantly predicted SSQ and explained 20.1% of the variance. In resilient adults, changes in sleep onset difficulties (β=-.325, p=.001), nocturnal and early awakenings (β=-.374, p=.000), and weekdays sleep duration (β=.192, p=.009) significantly predicted SSQ and explained 46.0% of the variance.
Conclusion: Our results suggest that resilience appears to be a protecting factor in the impacts of sleep difficulties on sleep quality, but only in adolescents. Indeed, in young adults, sleep difficulties seem to be a more important factor modulating sleep quality than changes in sleep duration. These results underline the importance of focusing on the intrinsic characteristics of each population to better target interventions.
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SLEEP IN HEAVY MARIJUANA USERS AFTER SMOKING DIFFERING THC DOSES COMPARED TO CONTROLS

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Introduction: Sleep disturbances are commonly reported by chronic marijuana (MJ) users and often identified as reasons for MJ relapse and/or other drug use. In the current study we compared the sleep architecture of 12 heavy MJ users to 11 normal controls.
Methods: Participants in the marijuana group met DSM-V criteria for cannabis use disorder but were otherwise healthy individuals. On the first study day, individuals smoked (1330-1400 hr) 11 puffs from a cannabis cigarette (7% THC). During the next four days, under varying experimental contingencies participants smoked an average of 4.58 (±3.48) day 1, 4.92 (±3.62) day 2, 4.75 (±3.52) day 3, and 4.17 (±3.56) day 4 puffs from cannabis cigarettes (7% THC). Their sleep was recorded the first four study nights using standard polysomnography procedures at Henry Ford Sleep and Research Center Hospital, under an 8-hr fixed time in bed (2300-0700 hr). Controls (n=11) had no history of illicit drug use or medical illness and were not shift workers. Neither group reported a history of sleep-related disorders. PSG recordings were scored using Rechtschaffen and Kales standard criteria. Sleep measures included sleep efficiency (total sleep time/time in bed * 100), latency to persistent sleep, and percent of time spent in Stage 1, 2, 3/4, and rapid eye movement (REM).
Results: PSGs taken across all four nights of inpatient stay showed that MJ users spent significantly more time in REM sleep compared to controls (means 24.91, 24.64, 24.42, 24.13 vs 18.81, p<.001) and less time in stage 3/4 sleep (means 4.33, 4.79, 4.53, 6.91 vs 15.68, p<.001). MJ users showed reduced sleep efficiency compared to controls on night 4 (means 82.03 vs 90.32, p=0.039), and increased latency to persistent sleep on night 1 (means 6.04 vs 17.77, p=0.026).
Conclusion: These data show reduced sleep efficiency, lightened sleep (reduced stage 3/4), as well as an increased duration during REM sleep in heavy MJ users during decreased use, findings that are predictive of relapse in other drug abuse populations.
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BIDEN WON, BUT SLEEP LOST IN THE 2020 US ELECTION

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Introduction: The 2020 US Presidential Election captivated the US public resulting in record turnout. In the months preceding the elections COVID-19, racial injustice and the economic downturn had a daily impact on the lives of voters. In this research, we analyze the sleep behavior of Americans in the lead up to the Presidential Elections. We examine specifically the nights of the Presidential and Vice-Presidential Debates and Election Night.
Methods: We examined sleep data from the PSG-validated SleepScore Mobile Application, which uses a non-contact sonar-based method to objectively capture sleep-related metrics and self-reported lifestyle data. The data set included 123,723 nights (5,967 users residing in the US, aged 18-85, mean age: 46.6 +/- 16.7 years, 52.3% female). Data from September 1st until November 3rd were included. This covered the nights of the Presidential Debates (Tuesday 09/29/2020 and Thursday 10/22/2020) and the Vice-Presidential Debate (Wednesday 10/07/2020). Election night was Tuesday, November 3, 2020. Self-reported stress level (0-24 scale) and alcohol consumption (0-9 drinks) were measured using digital slider scales. Mixed Effect Modelling was used for analysis.
Results: The night of the 1st Presidential debate saw a change in sleep-related behavior with users going to bed 9.5 minutes later, as compared to a regular Tuesday Night. This resulted in a decrease in both TST (11.5 mins, p<0.001) and TIB (11.8 mins, p<0.001). Interestingly, neither the the 2nd Presidential Debate, nor the Vice Presidential Debate resulted in significant differences in sleep behavior. On election night users went to bed 14.5 (p<0.001) min later on average, as compared to a normal Tuesday Night. This resulted in a decrease in both TIB (24.3 mins, p<0.001) and TST (19.2 mins, p<0.001). Self-report data showed a 13.3% (p<0.001) increase in stress level on election night and 34.4% (p<0.001) increase alcohol consumption Importantly, election night was two nights after the end of Daylight Savings Time (DST), Sunday, November 1st.
Conclusion: This analysis shows the 2020 US Presidential election negatively impacted US population sleep. The impact was most pronounced on election night, but also observed following the first Presidential debate. The effect of DST on these findings is unknown but surmised to be meaningful.
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COMPARING SLEEP AMOUNT AND QUALITY FOR PEOPLE WORKING FROM HOME WITH AND WITHOUT MINOR DEPENDENTS DURING THE COVID-19 PANDEMIC

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Introduction: The global pandemic due to the novel coronavirus (COVID-19) has had unprecedented effects on society, in particular for those who are also working with children in the household. The aim of this analysis was to evaluate sleep amount and sleep quality during the COVID-19 pandemic compared to before COVID-19 for those working from home with minor household dependents.
Methods: We developed the "Anonymous Survey on Confinement during the COVID-19 Pandemic", a national survey for individuals ≥18 years of age hosted on the Penn Medicine Clinical Research website from May 16th to November 11th, 2020. This 200 question survey captured demographics and multiple dimensions of health and well-being, including stress, sleep, eating behaviors, and coping activities. Respondents who indicated they were working from home were stratified by whether they were living with ≥1 minor dependent vs no dependents. Separate ordinal logistic regression models were used to evaluate associations between living with a minor dependent and sleep amount (less, same, more) and disturbed quality (none, less, same, more) during, compared to before, COVID-19 controlled for age, sex, ethnicity, and annual income.
Results: A total of 232 respondents (n=182 no dependents, n=50 dependents, 84.9% Caucasian) reported working from home, the majority of which had been in confinement (95.7%). Respondents with dependents were younger (mean age 38.9±13.5 vs 47.4±18.0, p=0.002) and mostly female (86% vs 76.9%, p=0.03). On average, reported days worked/week (3.5±2.4 days) and hours worked/day (5.5±4.17 hours) were similar regardless of dependents. Comparing those without to those with minor dependents, there were no significant differences in log odds of getting enough sleep (β=-0.38, p=0.25) or worse sleep quality (β=0.41, p=0.22) during the COVID-19 pandemic compared to before COVID-19. Respondents with dependents reported a higher log odds of taking longer to fall asleep during COVID-19 (β=0.71, p=0.045), and higher stress (β=-0.65, p=0.04).
Conclusion: In this mostly Caucasian female sample of people working from home, having minor dependents in the household did not significantly impact sleep amount or quality compared to no minor household dependents. However, respondents with dependents reported longer time to fall asleep and were more stressed.
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SLEEP SCHEDULE CHANGES DURING THE COVID-19 PANDEMIC: RELATIONS TO CIRCADIAN PREFERENCES

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Introduction: The COVID-19 pandemic profoundly altered individual lifestyles, reducing commutes and restricting nocturnal in-person socialization. We examine whether the stay-at-home orders and the attendant increase in sleep scheduling autonomy, impact bedtimes and waketimes and influence circadian preference alignment.
Methods: We compared bedtimes and wake times during the 4 weeks before and after a March 19th, 2020 stay-at-home order announcement. Data from the PSG-validated SleepScore Mobile Application were analyzed. Users answering a circadian preference question (a five-point Likert scale ranging from "definitely a morning person" to "definitely an evening person") who also recorded 10 or more nights of sleep both before and after the March 19th announcement were included in the analysis. The data set included 69,656 total nights of sleep from 1,487 users: 51.0% female, age range 18 to 91 years (mean = 50.3 +/- 30.3). Differences in average bedtime and wake time before and after March 19th were compared using paired sample t-tests. Associations between circadian preference and changes in bedtime and wake time were examined using Spearman's correlation coefficient.
Results: All five circadian preference groups showed a significant delay in both bedtime and wake time ($p < .01$) after the March 19th announcement. Greatest delays were observed in those reporting the strongest eveningness preference, with median bedtimes being 17 minutes later and wake times 33 minutes later. Delays were smallest in users with the strongest morningness preference, with bedtimes being 7 minutes later and wake times 12 minutes later. Wake time delay was significantly greater than bedtime delay for evening types ($p < 0.001$) but not morning types. Eveningness preference was associated with greater bedtime delay (Spearman correlation = 0.098, $p <0.001$) and wake time delay (Spearman correlation= 0.178, $p < 0.000001$).
Conclusion: The stay-at-home order provided many individuals more freedom to choose their sleep schedule. This increased sleep scheduling autonomy was associated with delayed bedtimes and wake times for each circadian preference group, with the evening-types exhibiting the greatest shift towards a later sleep schedule. We conclude that stay-at-home orders allowed evening types to choose sleep schedules more aligned with their natural tendencies.
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SOCIAL INTEGRATION AND SLEEP QUALITY DURING THE COVID-19 PANDEMIC: PROSPECTIVE EVIDENCE FROM A STUDY OF RETIRED OLDER ADULTS

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Introduction: Growing evidence has documented the adverse impact of the global coronavirus pandemic on sleep quality. Older adults may be especially susceptible to declines in sleep quality for multiple reasons, including their elevated risk of social isolation and loneliness during the pandemic. Given the adverse health consequences of poor sleep, there is a need to identify resilience factors that help protect older adults against decreased sleep quality. Social integration is a plausible resilience factor because involvement in a broad range of social relationships is thought to promote psychological well-being (e.g., meaning, purpose in life), as well as reduce the intensity and duration of negative psychological states. Social integration may also assume increased importance during the coronavirus pandemic because of normative declines in overall social contact. This prospective study assessed the impact of the coronavirus pandemic on older adults' sleep quality and tested whether social integration moderated the impact of the pandemic on sleep quality.
Methods: A sample of 115 retired older adults (mean age = 68.6, 58% female, 89% white) completed self-report assessments of their social integration (number of roles on Cohen's Social Network Index) and sleep quality (global score on Pittsburgh Sleep Quality Index) before and after the onset of the coronavirus pandemic (mean duration of follow-up = 2.3 years).
Results: Multilevel analyses indicated that social integration moderated the impact of the coronavirus pandemic on sleep quality; there was no main effect of time. Older adults with low social integration had reduced sleep quality from Time 1 to Time 2 (b=.94, p=.02), whereas older adults with high social integration showed no changes in sleep quality over time (b=-.38, p=.37).
Conclusion: Broader social networks confer resilience against pandemic-related declines in sleep quality among older adults. The level of social integration should be addressed when studying or

treating sleep complaints during the coronavirus pandemic. Additional research is warranted to determine whether psychosocial interventions targeted towards older adults with low social integration can reduce observed differences in sleep quality.

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COVID-19 RELATED STRESS INTENSIFY THE IMPACT OF CHILD MALTREATMENT ON SLEEP QUALITY

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Introduction: Child maltreatment (CM) is a significant stressor that is associated with sleep problems in children and adolescents. The COVID-19 pandemic introduces new psychosocial stressors, which may be particularly harmful to youth already experiencing stress in the home environment. Using multi-dimensional (threat vs deprivation) assessments of CM, the present study aimed to test whether COVID-19 related stress intensified the association between maltreatment (abuse vs neglect) and sleep problems among youth.

Methods: This study utilized data from a longitudinal sample of youth (N=126; Mage at T1=12.9) assessed between January 2019 and March 2020 (T1) and after the beginning of the COVID-19 pandemic (May 2020; T2). Latent factors for COVID-19 related stress included three questions asking about negative changes, uncertainty about the future, and stress-induced by disruptions. CM at T1 was measured with the Childhood Trauma Questionnaire (CTQ). Multidimensional aspects of CM included a threat factor (sum of Emotional, Physical, and Sexual Abuse) and a deprivation factor (sum of Emotional and Physical Neglect). Sleep-related problems at both T1 and T2 were assessed using the Pittsburgh Sleep Quality Index (PSQI) global score. Structural equation modeling was conducted in Mplus 8.1 to test direct and interaction effects of CM and COVID-19 related stress on sleep problems at T2 while controlling for sleep problems at T1 and demographic covariates.

Results: Threat-related abuse was significantly associated with increased sleep problems at T2 (β =.43, $p < .01$) but neglect was not (β =.03, p = .85). Additionally, COVID-19 related stress significantly intensified the link between abuse and sleep problems (β =.14, $p < .05$) as well as between neglect and sleep problems (β =.43, $p < .01$) at T2. Among youth who experienced higher levels of CM, increased COVID-19 related stress exacerbated sleep problems.

Conclusion: These results bolster extant research on the negative impact CM bears on youth sleep health and indicates that COVID-19 stress may exacerbate sleep problems. Our findings inform future prevention and intervention efforts that aim to reduce sleep problems among youth who experience CM during the COVID-19 pandemic.

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SLEEP DURATION AND SLEEP QUALITY IN CHRONIC CANNABIS USERS AND NON-USERS

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Introduction: Cannabis use is on the rise in the United States, with 10% of adults reporting cannabis use in the past 30 days. Users commonly report consuming cannabis to improve sleep despite the lack of research that supports an association between cannabis use and sleep. In this pilot study we sought to examine objective measures of sleep duration and sleep quality among non- and chronic-cannabis users, and any patterns in relation to the time since consumption of cannabis.

Methods: Chronic cannabis users (cannabis used 2 or more times/week) and non-users provided up to 2-weeks of actigraphy (ActiGraph wGT3X-BT), worn on the wrist and verified by sleep diary. Chronic cannabis users also reported the date, time, amount, and route of their cannabis use. Mixed-effects models with participant as a random factor were used to examine: 1) the relationship between daily sleep parameters in cannabis non-users vs. users; and 2) the elapsed time between cannabis use and time in bed in chronic cannabis users.

Results: Chronic cannabis users (n=6) and non-users (n=7) collectively provided 151 nights of sleep. Participant characteristics (38.5% female; age, 25.8 years ± 4 years; BMI, 23.4 kg/m2 ± 3.4 kg/m2) did not significantly differ between groups. Cannabis use was associated with decreased total sleep time (measured in hours, ß=-0.58, p<0.001) and increased wake after sleep onset (WASO, ß=32.79, p=0.005), but not with the number of awakenings (ß=6.02, p=0.068). Among chronic cannabis users, cannabis use within two hours of bed was associated with increased sleep latency compared to use greater than two hours (ß=6.66, p=0.026). There was no association between time of cannabis use and WASO (p=0.621) or the number of awakenings (p=0.617).

Conclusion: In this pilot study of objectively measured sleep, we found that chronic cannabis use compared to non-use is associated with decreased sleep duration of otherwise healthy adults. Cannabis used closer to bedtime is associated with increased sleep latency. Additional studies that are able to assess the mode and dosage of use are needed to further understand the effects of cannabis and its components on sleep.

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DIGITAL MEDIA USE AND SLEEP IN COLLEGE STUDENTS DURING COVID-19 PANDEMIC

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Introduction: To address the growing sleep deficiency epidemic in college students, more research is needed on recent factors that might affect sleep, such as the digital media use in this young adult population. Furthermore, sleep and the use of digital media can be heavily influenced by the COVID-19 pandemic. The purpose of this study is to examine the use of digital media during the pandemic, and its relationship with sleep disturbance, social isolation, physical and mental health in college students.

Methods: An online survey was sent out to college students enrolled in an urban university. Validated questionnaires including PROMIS (Sleep Disturbance, Global Mental Health, Global Physical Health, Social Isolation), Nighttime Media Usage, and Internet Addition Test were included in the survey. In addition, focus groups were conducted with a subsample of survey respondents to elicit a comprehensive understanding of how digital media use in daily life influences sleep during the COVID-19 pandemic. Data collection was conducted during June to December 2020.

Results: A total of 358 students completed the online survey. Sleep disturbance was significantly related to greater digital media use for recreational purposes two hours before bedtime (62.6±28.1 minutes, r=0.110, p=0.046), and a higher frequency of playing games (r=0.148, p=0.007) and using social media after going to bed (r=0.142, p=0.10).

Sleep disturbance was significantly associated with social isolation (r=0.251, p<0.001), poor global physical health (r=-0.186, p<0.001) and mental health (r=-0.376, p<0.001), and lower GPA (r=-0.167, p=0.004). Additionally, seven focus groups were conducted in a total of 32 students, suggesting that the increase in free time from the COVID-19 pandemic led to greater digital media use, compromising sleep duration and quality. With the increase of screen time also came feeling of guilt and anxiety which often led to greater awareness and self-control around media use.
Conclusion: Nighttime digital media use during the challenging pandemic time has a significant impact on poor sleep, which may lead to decreased academic performance, greater social isolation, and poor physical and mental health in college students. Effective interventions targeting digital media use are needed to improve sleep in this population.
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SLEEP TIMING AND CHRONOTYPE IN MOTHERS: LONGITUDINAL CHANGES AND ASSOCIATIONS WITH WELLBEING FROM PREGNANCY TO 2 YEARS POSTPARTUM

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Introduction: Women experience significant changes to sleep during perinatal periods. Existing research focuses on sleep duration and quality, but not sleep timing or chronotype (i.e., preferred timing for activity and sleep). This study investigated change trajectories of sleep timing and chronotype from late pregnancy to two years postpartum, and examined longitudinal associations between chronotype and insomnia, sleep-related daytime impairment, and mood.
Methods: Data were from a 2-arm randomized controlled trial testing behavioral sleep and diet interventions. A community sample of nulliparous women without severe sleep/mental health conditions participated. Women self-reported bedtime, risetime, chronotype (reduced Morningness-Eveningness Questionnaire), Insomnia Severity Index, and PROMIS Depression, Anxiety, and Sleep-Related Impairment over 7 time points: 30 and 35 weeks' gestation, and postpartum months 1.5, 3, 6, 12 and 24.
Results: 163 women (mean age 33.35 ± 3.42 years) took part. Mixed effects models controlling for age and group allocation showed that both bed- and risetimes became progressively earlier over time by approximately 20-30 minutes on average ($p < .001$); chronotype also shifted progressively towards morningness ($p < .01$). After controlling for covariates (sleep duration and efficiency, mental health history, social support, age, group allocation), greater morningness was significantly associated with lower symptoms of insomnia and sleep-related impairment over time (p-values < .001); longitudinal associations between chronotype and symptoms of depression and anxiety were non-significant (p-values > .65).
Conclusion: This is one of the first studies to examine longitudinal changes in sleep timing and chronotype from pregnancy to two years postpartum. Sleep timing and chronotype became progressively earlier over the first two postpartum years. The magnitude of changes is beyond what is expected with increasing age. Greater morningness was associated with lower sleep complaints and sleep-related daytime impairment during the postpartum period. The mechanisms underlying these associations require further research.
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CHANGES IN SLEEP AMOUNT AND SLEEP QUALITY DUE TO THE COVID-19 PANDEMIC CONFINEMENT ASSOCIATE WITH RATINGS OF HEALTH AND STRESS

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Introduction: In March 2020, an unprecedented number of individuals were confined to their homes in an effort to stem the spread of the novel Coronavirus (Covid-19), however the impact of this confinement on health and behavior is unknown. Long-duration confinement studies have found effects on homeostatic biology and neurobehavioral functions, including reduced sleep durations. This study evaluated how confinement due to Covid-19 has impacted health and stress through changes in sleep.
Methods: The Anonymous Survey on Confinement during the COVID-19 Pandemic was available online to any individual ≥18 years of age through the Penn Medicine Clinical Research webpage on May 14, 2020 and the data presented are through October 24, 2020. The survey collected self-reported information on demographics, the amount and quality of sleep, as well as ratings of health and stress. To determine the impact of confinement on these domains, participants were asked to answer questions relative to pre-confinement levels. To test associations between sleep amounts and sleep quality on health and stress, generalized linear models were used and adjusted for age, sex, and race.
Results: N=228 participants (n=180 female [79.0%]) were on average 45.0±17.1 years of age. During confinement relative to pre-confinement, 41.7% of participants reported sleeping more, 37.3% reported sleeping the same amount, and 21.0% reported less sleep, while 14.0% reported better sleep quality, 47.4% the same, and 38.6% worse quality of sleep relative to pre-confinement. Ratings of worse health during confinement were associated with both reduced sleep amount (β=0.695; P<0.0001) and worse sleep quality (β=0.532; P=0.0002). Lower stress ratings were associated with increased sleep amount (β=0.734; P=0.034), better sleep quality (β=1.396; P=0.0002), better health ratings (β=-0.079; P=0.0045). Conversely, worse sleep quality was associated with higher stress ratings (β=-1.086; P=0.0007).
Conclusion: The confinement resulting from the COVID-19 pandemic has impacted the amount and quality of sleep and good sleep may help to reduce stress and maintain health. These findings highlight the need to further examine how long-term confinement influences human health and behavior and warrant examining what factors or life-style behaviors promote resilience to the negative effects of confinement.
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POOR SLEEP AS A PREDICTOR OF COVID-19 RELATED STRESS, FEAR AND SADNESS IN YOUNG ADOLESCENTS: A LONGITUDINAL STUDY

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Introduction: Adolescence is a transitional life-stage accompanied by large biopsychosocial changes and greater psychophysiological vulnerability. Global events like the COVID-19 pandemic may increase vulnerability to depression and anxiety in this population. Poor sleep is often associated with depression, and both sleep and mood

have been shown to be strongly impacted by the COVID-19 pandemic, with most studies focusing on adults. The current study investigates psychological distress in young adolescents during the pandemic, and specifically, whether poor sleep before the pandemic predicts psychological distress.

Methods: Self-report data were analyzed from 3099 adolescents (9-10 years at baseline) in the population-based, demographically diverse, Adolescent Brain Cognitive Development (ABCD) study across three pre-pandemic annual visits and 3 monthly time points during the COVID-19 pandemic (ages 11-13 years). At each assessment, children and their guardians completed questionnaires including those about sleep, environment, and psychological wellbeing. Gradient Boosted Tree machine learning algorithms were used to identify the strongest predictors of pandemic-related psychological distress in individuals. We trained models using pre-pandemic sleep measures along with demographics, economic, and social measures during the pandemic. We evaluated the performance of the models using area under curve (AUC) metrics and interpreted the models by using the recently proposed SHapley Additive exPlanations methodology.

Results: Pandemic-related perceived stress, fear and sadness were accurately detected with our classifiers (AUC = 0.83 for perceived stress, AUC = 0.73 for fear, AUC = 0.79 for sadness). Across all models, shorter sleep duration, prolonged sleep onset latency, and longer time between waking and getting out of bed predicted greater distress. Moreover, female sex, and pandemic-related factors, including greater family conflict, fewer economic resources, and more screen time contributed to prediction performance in all three models.

Conclusion: Findings highlight the importance of addressing sleep problems and ensuring sufficient sleep duration in children to protect against the psychological impact of major life events, including the COVID-19 pandemic. Considering the long-lasting effects of sleep, it would be crucial to improve sleep health by targeted prevention, intervention and increased awareness among adolescents.

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THE ASSOCIATION OF PRIOR MENTAL HEALTH CONDITIONS WITH COVID-19-RELATED SLEEP CHANGES

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Introduction: Among persons with mental health conditions, the impact of the COVID-19 pandemic on sleep health is underexplored. The present study investigated whether sleep changes related to the COVID-19 pandemic differed among individuals with mood and/or anxiety disorders compared to individuals without these disorders.

Methods: A 25-minute online survey, distributed globally to adults aged >18y through social media advertising from 5/28/2020-7/10/2020, examined the association of mental health diagnoses with COVID-19 related sleep changes. Participants reported prior history of mood and anxiety disorders, and pre-COVID-19 and current sleep patterns including bedtime, wake time, total sleep time (TST), sleep efficiency (SE:[TST/time in bed*100%], and nightmare frequency/wk. ANOVA models comparing mental health disorder groups (no diagnoses, mood disorders, anxiety disorders, mood and anxiety disorders) on mean differences in sleep changes were conducted.

Results: Among 1,048 participants, 71.5% reported no prior mood and/or anxiety disorders9.3% reported anxiety disorders only, 4.3% reported prior mood disorders only, and 14.9% reported both mood and anxiety disorders. There were significant group differences in total sleep time (F (3,670)=4.6, p=0.003) and sleep efficiency (F (3,670) =2.8, p=0.038) such that individuals with both mood and anxiety disorders experienced greater decreases in total sleep time (Mean Difference: 39.0min, SE=13.0) and sleep efficiency (Mean Difference=3.8%, SE=1.6) compared to individuals without any mood or anxiety disorders. In addition, the model for nightmare frequency per week was significant (F(3,654)=5.6, p=0.001) such that individuals with both anxiety and mood disorders (Mean Difference=1.1, SE=0.4) and individuals with mood disorders only (Mean Difference=1.1, SE=0.4) reported greater increases in nightmare frequency compared to participants without any mood or anxiety disorders. There were no group differences in bedtime and wake time.

Conclusion: Among a global sample, COVID-19 pandemic-related sleep health significantly worsened among individuals with prior mood and anxiety disorders relative to individuals without these disorders.

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SLEEP-WAKE BEHAVIOR, MEAL TIMINGS AND DIGITAL MEDIA DURATION OF INDIANS DURING COVID-19 LOCKDOWN

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Introduction: Lockdown and stay home order has been imposed on people in many countries including India to prevent the community transmission of COVID-19 pandemic. However this social restriction led to disturbed daily routine and lifestyle behaviour that is needed to be attended for proper therapeutic management of overall health during such crisis. The impact of lockdown on the most apparent behavioral changes viz. sleep-wake behaviour, major meal timings, and digital screen duration of Indians were investigated. In addition the effects of gender and age were explored.

Methods: After seeking permission from Ethical Institution, an online questionnaire based survey was circulated within India in the first week of May, 2020 for which total 1511 male and female (age ≥18 years) subjects participated. The sleep-wake behavior observed were sleep-wake timings, sleep duration, mid sleep time (MST) as function of lockdown, and social (lockdown) jetlag (SJL = MST before lockdown-MST during lockdown).

Results: The sleep onset-wakeup and meal times were significantly delayed during lockdown, which was more pronounced in younger age group. The sleep duration increased, specifically in young individuals during lockdown. Females showed more delayed sleep onset-waking times and first meal timing with longer sleep duration during lockdown. Increased digital media duration was observed in all age groups, primarily in males. The younger age group and specifically female reported higher SJL and delayed MST. A positive association was obtained between sleep duration & first meal time, and SJL & major meal timings/screen duration, and a significant negative relationship of sleep duration and SJL with age.

Conclusion: The study shows delayed sleep-wake schedule, meal timings and increased digital media duration among Indians during COVID-19 lockdown compared to before lockdown. Also, gender and age emerged as important mediating factors for this alteration. The pandemic has given opportunity to sleep more and compensate for the sleep. In spite of that, the higher social jetlag in young age group and female showed the compromised sleep and maladaption with societal timing. These findings have applied implications in sleep health during longer social isolation conditions and for proper therapeutic management.

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ASSOCIATION BETWEEN CHRONOTYPE AND SUBJECTIVE COGNITIVE FUNCTIONING: POPULATION-BASED STUDY

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Introduction: Increasing research suggests that subjective cognitive decline (SCD) in the absence of objective cognitive dysfunction may be a forerunner of non-normative cognitive decline and eventual progression to dementia. We investigated the association between chronotype and subjective cognitive functioning in the representative sample of the adult population.
Methods: We included subjects who participated in a nationwide cross-sectional survey of sleep and headache in 2018 in the Republic of Korea. A total of 2136 subjects (age 19-92, mean 48.3 ± 16.5 years old, 1062 male) was included in the analysis. To assess subjective cognitive functioning, we adopted the Mail-In Cognitive Function Screening Instrument (MCFSI). The MCSFSI is a brief, self-administered potential outcome measure developed by the Alzheimer's Disease Cooperative Study (ADCS) to detect early changes in cognitive and functional abilities in individuals without clinical impairment. MCFSI scores ≥5 were considered abnormal for this study. As an indicator of chronotype, we adopted the "midpoint of sleep on free days corrected for sleep extension on free days (MSFsc)." MSFsc was calculated as follows: MSFsc = midpoint of sleep on free days − 0.5 × (sleep duration on free days − [5 × sleep duration on workdays + 2 × sleep duration on free days]/7). Participants whose MSFsc occurred before 04:00 AM, between 04:00 and 04:59 AM, and after 05:00 AM were classified as early, intermediate, and late chronotype, respectively. The associations between chronotype and subjective cognitive functioning were analyzed with logistic regression models adjusted for potential confounders.
Results: Subjective cognitive functioning was abnormal in 381 subjects (17.8%). A late chronotype was significantly associated with abnormal subjective cognitive functioning compared with an early chronotype independent of age, sex, average sleep duration, alcohol, smoking, regular exercise, anxiety, depression, body mass index (BMI), education years, and income status (OR 1.619, 95% CI 1.03 - 2.55, p=0.038). Abnormal subjective cognitive functioning was significantly associated with older age, female sex, lower education, higher BMI, anxiety, and depression.
Conclusion: This survey cohort results provide evidence at the population level that late chronotype is associated with abnormal subjective cognitive functioning.
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COVID-19 LOCKDOWN POLICIES ACROSS 20 COUNTRIES MODULATE SLEEP AND RESTING HEART RATE MEASURES

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Introduction: Lockdowns imposed to stem the spread of COVID-19 have disrupted the lifestyles of many worldwide, but studies to date are mostly confined to observations within a limited number of countries, based on subjective reports and survey from a narrow time window. In the present study, we investigate associations between the severity of lockdown policies and objective sleep and resting-heart rate measures.
Methods: Data from 113,000 users of a consumer sleep tracker across 20 countries were gathered between Jan–Jul 2020 and compared with an equivalent period in 2019 as a control for naturally occurring seasonal fluctuations. Lockdown stringency was derived using scores from the Oxford Government Response Tracker. Multilevel growth curve models were used to quantify the effect of lockdown stringency on changes to sleep patterns (midsleep time and midsleep variability) and resting heart rate changes, and to predict changes in resting heart rate from changes to sleep patterns.
Results: Lockdown severity modulated the size of shifts in sleep midpoint and regularity during this period. Midsleep times were delayed in all countries during strict lockdowns, particularly on weekdays, while midsleep variability reduced. The largest shifts in midsleep time (+0.09 to +0.58 hours), midsleep variability (–0.12 to –0.26 hours) and resting heart rate (–0.35 to –2.08 bpm) occurred in April and May - when most countries imposed their strictest lockdown measures. In addition, multilevel modelling revealed that for each unit increase in stringency index, midsleep time was delayed by 0.96 min, midsleep variability decreased by 0.46 min and resting heart rate decreased by 0.06 bpm. Finally, in models predicting changes in resting heart rate from changes to sleep patterns, midsleep variability was shown to be the strongest predictor of resting heart rate, wherein an hour increase in the standard deviation of midsleep variability predicted a 5.12 increase in bpm, while an hour increase in midsleep time only predicted a 1.25 decrease in bpm.
Conclusion: Our findings demonstrate the utility of large-scale data from consumer wearables in providing population-level insights into how lockdown severity directly impacts sleep health during this pandemic period.
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COVID STRESS AND SLEEP DISTURBANCE AMONG A RACIALLY/ETHNICALLY DIVERSE SAMPLE OF ADOLESCENTS: ANALYSIS FROM THE NESTED STUDY

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Introduction: Using data from the Nationwide Education and Sleep in TEens During COVID (NESTED) study (N=6,578), we investigated if race/ethnicity (64.6% were White and 35.4% identified as a racial/ethnic minority, mixed, or "other") and community social vulnerability affected the association between COVID stress and sleep disturbance.
Methods: Data on sociodemographic factors (age, race, sex, grade, zip code [for neighborhood social vulnerability index, SVI]), COVID-related stress, depression, anxiety, instructional format (online, in-person, or hybrid), and sleep disturbance (PROMIS Pediatric Sleep Disturbance) were captured through an online survey. Descriptive and inferential analyses (Hierarchical Binary Logistic Regression (HBLR), SPSS v. 25) in 4171 adolescents examined associations between sleep disturbance and COVID-related stress, adjusting for race, sex, SVI, grade level, learning format, household density, and mental health factors.

Results: Sleep disturbance was prevalent among adolescents (89% above average, T-score >50); about two-thirds (64.4%) reported greater stress due to the pandemic. Compared to White (88.5%) adolescents, sleep disturbance was more common in Black (91.2%), Hispanic (90.5%), American Indian/Alaska native (95.1%), and Mixed (92.3%) and less common in Asian (83.9%) adolescents. Chi-square analysis indicated that both race/ethnicity (□2 = 14.96, p<.05) and SVI (□2 = 8.34, p<.05) had an effect on sleep disturbance. HBLR analysis indicated that compared to pre-pandemic, adolescents reporting "little stress" (OR=.70, 95% CI= .49-.99, p=.04) or "the "same amount of stress" (OR=.64, 95% CI= .47-.89, p=.007) had lower odds of sleep disturbance. Higher depression (OR=1.06, 95% CI=1.04-1.07, p<.001) and anxiety (OR=1.05, 95% CI=1.04-1.07, p<.001) symptoms increased odds of sleep disturbance, while male gender lowered odds of sleep disturbance (OR=.11, 95% CI=.015-.86, p<.05). Overall, race/ethnicity (p=.44) and SVI (p=.45) did not independently predict sleep disturbance. Race/ethnicity stratified analyses indicated that for Black and Hispanic adolescents, being in grades 11/ 12 and depression predicted sleep disturbance; and for Asian adolescents SVI and anxiety predicted sleep disturbance.
Conclusion: COVID-related stress and symptoms of depression and anxiety are associated with sleep disturbance. We observed differences in sleep disturbance across racial/ethnic groups and neighborhood social vulnerability strata, for specific racial/ethnic groups.
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COVID-19 RELATED WORRIES AND SLEEP DISTURBANCES IN PATIENTS PREVIOUSLY HOSPITALIZED WITH COVID-19 ILLNESS

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Introduction: In patients hospitalized for COVID-19 illness, sleep disturbances after discharge may impact quality of life and prognosis. We examined the relationship of COVID-19-related worries with sleep disturbances in patients three months after COVID-19 hospitalization.
Methods: Patients hospitalized for COVID-19 illness completed a survey three months post-discharge (n=153). We measured COVID-19-related worry along two domains: worry directly related to the disease (COVID-illness worry) and worry related to the socioeconomic impact of the pandemic (COVID-impact worry). COVID-illness worry included worry regarding: 1) getting COVID again, 2) dying from COVID, 3) family members getting COVID, 4) losing a loved one to COVID, 5) unknowingly infecting others with COVID, 6) having significant financial burdens because of COVID. COVID-impact included worry regarding: 1) employment loss, 2) not having enough food, 3) not having access to medical care/medications, 4) not having access to mental health care/medications, 5) reduction in interactions with other people, 6) separation from family members, 7) being lonely. Patients rated how much they worried about each item on a 4-point scale (not at all, a little, moderately, extremely). Scores on each domain were summed to reflect overall severity. Past month sleep was assessed for insomnia symptoms (none, mild, moderate, severe, very severe) and self-reported sleep duration. Binary logistic regression was used to evaluate the association of COVID-illness worry and COVID-impact worry, separately, with sleep measures, adjusting for age, sex, race/ethnicity, and presence of persistent COVID-related symptoms.
Results: The prevalence of insomnia (moderate, severe, or very severe symptoms) and short sleep duration (<6 h/day) was 47.0% and 39.2%, respectively. COVID-illness worry severity was significantly associated with presence of insomnia (OR: 1.91, 95% CI: 1.13-3.23, p=0.016) and short sleep (OR: 2.20, 95% CI: 1.25-3.86, p=0.006). In a separate model, COVID-impact worry severity was significantly associated with presence of insomnia (OR: 1.98, 95% CI: 1.23-3.19, p=0.005) and short sleep (OR: 2.11, 95% CI: 1.26-3.55, p=0.005).
Conclusion: Sleep disturbances are common among patients previously hospitalized with COVID-19 illness, and COVID-19 related worries are associated with insomnia and short sleep. Additional research is needed to determine whether addressing COVID-19 related worries reduces sleep disturbance, which in turn may promote post-COVID recovery.
Support (if any):

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SLEEP QUALITY DURING THE CORONAVIRUS PANDEMIC IN A BRAZILIAN FAMILY-BASED COHORT

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Introduction: Early in the COVID-19 pandemic, Brazil adopted measures to minimize the spread of the virus, including quarantine orders where people only left home for essential business. This practice could negatively impact sleep by reducing exposure to daylight and physical activity. We examined subjective sleep quality in Baependi, a small rural town in Brazil during the COVID-19 quarantine order.
Methods: This sample is from the Baependi Heart Study, a family-based cohort of adults. Participants (n=800, 71% women, mean age 51.6±15.6 years) completed the Pittsburgh Sleep Quality Index (PSQI) early in the COVID pandemic (April-May, 2020). They were also asked about their compliance to the quarantine order (yes/no). We compared sleep between quarantined (QT) and not-quarantined individuals (NQT). Longitudinal data was obtained from a subsample of 417 individuals who also completed a pre-COVID PSQI between January, 2010 and September, 2014.
Results: Individuals compliant with the quarantine had worse sleep quality than non-quarantined individuals [QT PSQI= 6.1 (±3.9), NQT PSQI= 5.0 (±3.5), p<0.01]. Stratified analysis showed that differences in PSQI scores between QT and NQT was greater for women [QT = 6.4 (±4), NQT = 5.2 (±3.7), p<0.01] and older people [QT = 6.6 (±0.1), NQT = 5.5 (±3.3), p=0.02]. Associations were attenuated after adjusting for age and gender. PSQI components demonstrated a higher sleep latency for the QT group in the full sample (p=0.02), women (p<0.01) and young (<50 years, p=0.03). Sleep duration was shorter in the QT young subsample (p=0.03). QT women also reported lower sleep efficiency (p=0.01) and greater use of sleep medication than NQT women (p<0.01). In the longitudinal subsample, PSQI scores were significantly higher during COVID than pre-pandemic [COVID= 5.7 (±3.8), pre-COVID= 5 (±3.3), p<0.01]. The significant change in PSQI was only observed in the QT participants [COVID= 5.9 (±3.7), pre-COVID= 5.2 (±3.4), p<0.01] and not NQT [COVID= 5 (±3.7), pre-COVID= 4.5 (±3), p=0.12.
Conclusion: Individuals who quarantined during COVID-19 had worse sleep quality than individuals who did not quarantine. Longitudinal comparison demonstrated that participants who quarantined had worse sleep quality during COVID compared to before to the pandemic.
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AGE AND CHRONOTYPE ASSOCIATED WITH SLEEP TIMING CHANGES DURING COVID-19-RELATED LOCKDOWNS IN THE US

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Introduction: Global lockdowns implemented to reduce spread of the Coronavirus Disease 2019 (COVID-19) have offered unique insight into how sleep patterns change when typical social obligations are significantly reduced. Here, we aimed to replicate findings of sleep timing delays and reduced social jetlag during lockdown using a large, regionally-diverse sample of participants from the United States (US). Further, we conducted exploratory analyses to determine if observed sleep changes were associated with age and self-reported chronotype.
Methods: A sample of 691 US adults (age 18-89) completed the Ultrashort Munich Chronotype Questionnaire twice during the same assessment: once querying retrospective memory for sleep patterns in the 6-weeks prior to February 1, 2020 (Pre-Lockdown) and a second time for sleep patterns in the 6-weeks prior to ~May 20th (Peak-Lockdown in the US). Participants also completed the abbreviated Morningness-Eveningness Questionnaire to assess chronotype. We compared sleep duration (SDur), sleep onset time (SO), sleep end time (SEnd), social jetlag (SJL; difference between work-day and free-day sleep midpoint) and social sleep restriction (SSR; difference between work-day and free-day sleep duration) Pre- to Peak-Lockdown. We conducted exploratory analyses to determine whether Pre- to Peak-Lockdown changes in these sleep metrics were associated with age or chronotype. Main analyses were preregistered with Open Science Framework (https://osf.io/4a3fx).
Results: During the Peak-Lockdown period, participants, on average, reported significantly later SO and SEnd times and significantly reduced SJL and SSR compared with the Pre-Lockdown period. Change in SJL and SSR Pre- to Peak-Lockdown was significantly positively associated with age and chronotype such that SJL and SSR decreased more during lockdown in younger participants and those with an evening chronotype.
Conclusion: Our results support lockdown-associated sleep timing delays and reduced SJL and SSR. Younger age and evening chronotype were associated with greater reductions in SJL and SSR during lockdown. These findings suggest that individuals, particularly young individuals and those with an evening chronotype, experience greatest desynchrony between intrinsic and social sleep timing when conforming to typical pre-pandemic social schedules.
Support (if any): Harvard Medical School Division of Sleep Medicine T32 HL007901 (RB and TJC); Brandeis University NIH NRSA T32 NS007292 (ECF)

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THE ASSOCIATION BETWEEN RECENT CANNABIS USE AND NIGHTLY SLEEP DURATION IN ADULTS IN THE USA FROM 2005-2018

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Introduction: Shifts in medicolegal attitudes towards cannabis, coupled with widespread legalization, have led to North America having the highest prevalence of cannabis use worldwide. Amongst other known physiologic effects, regular cannabis use can cause changes to sleep duration and quality. The purpose of this study was to examine the relationship between recent cannabis use and sleep duration using a nationally representative data set.
Methods: A cross-sectional analysis of adults was undertaken using the National Health and Nutrition Examination Survey (NHANES) data from 2005–2018. Respondents were dichotomized by whether or not they had used cannabis in the past 30 days. The primary outcome was inadequate nightly sleep duration, defined as self-reported sleep duration less than 6 hours per night. Secondary outcomes were related to self-reported issues with sleep. Multiple logistic regression was used to adjust for potential confounders and survey sample weights were considered in the model.
Results: Compared to those with no recent cannabis use (n=18,631), recent users (n=3,135) were more likely to report less than 6 hours of sleep per night (aOR 1.33 95% 1.13–1.57, p<0.001). Recent users were also more likely to report difficulty falling asleep, staying asleep, or sleeping too much in the past two weeks (aOR 1.21, 95% CI: 1.09–1.35, p<0.001), and having ever mentioned these issues to a physician (aOR 1.21, 95% CI: 1.07–1.37, p=0.003). Respondents using cannabis at least 20 of the past 30 days were characterized as heavy users, and were even more likely than moderate users to report insufficient sleep. These results did not significantly differ between years of survey administration.
Conclusion: Recent cannabis use was associated with inadequate nightly sleep duration in adults and demonstrates a dose-dependent relationship. Although this relationship is complex and our findings cannot suggest directionality, they highlight the need to further characterize the sleep health of regular cannabis users in the general population. This is especially prudent as cannabinoids are becoming widely accepted for recreational use and increasingly prescribed as medical therapy.
Support (if any):

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SLEEP DISTURBANCES, ONLINE INSTRUCTION, AND LEARNING DURING COVID-19: EVIDENCE FROM 4148 ADOLESCENTS IN THE NESTED STUDY

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Introduction: COVID-19 fundamentally altered education in the United States. A variety of in-person, hybrid, and online instruction formats took hold in Fall 2020 as schools reopened. The Nationwide Education and School in TEens During COVID (NESTED) study assessed how these changes impacted sleep. Here we examined how instruction format was associated with sleep disruption and learning outcomes.
Methods: Data from 4148 grade 6-12 students were included in the current analyses (61% non-male; 34% non-white; 13% middle-school). Each student's instructional format was categorized as: (i) in-person; (ii) hybrid [≥1 day/week in-person]; (iii) online/synchronous (scheduled classes); (iv) online/asynchronous (unscheduled classes); (v) online-mixed; or (vi) no-school. Sleep disturbances (i.e., difficulty falling/staying asleep) were measured with validated PROMIS t-scores. A bootstrapped structural equation model examined how instructional format and sleep disturbances predict school/learning success (SLS), a latent variable loading onto 3 outcomes: (i) school

engagement (ii) likert-rated school stress; and (iii) cognitive function (PROMIS t-scores). The model covaried for gender, race-ethnicity, and school-level

Results: Our model fit well (RMSEA=.041). Examining total effects (direct + indirect), online and hybrid instruction were associated with lower SLS (b's:-.06 to -.26; p's<.01). The three online groups had the strongest effects (synchronous: b=-.15; 95%CI: [-.20, -.11]; asynchronous: b=-.17; [-.23, -.11]; mixed: b=-.14; [-.19, -.098]; p's<.001). Sleep disturbance was also negatively associated with SLS (b=-.02; [-.02, -.02], p<.001). Monte-carlo simulations confirmed sleep disturbance mediated online instruction's influence on SLS. The strongest effect was found for asynchronous instruction, with sleep disturbance mediating 24% of its effect (b = -.042; [-0.065, -.019]; p<.001). This sleep-mediated influence of asynchronous instruction propagated down to each SLS measure (p's<.001), including a near 3-point difference on PROMIS cognitive scores (b = -2.86; [-3.73, -2.00]).

Conclusion: These analyses from the NESTED study indicate that sleep disruption may be one mechanism through which online instruction impacted learning during the pandemic. Sleep disturbances were unexpectedly influential for unscheduled instruction (i.e., asynchronous). Future analyses will examine specific sleep parameters (e.g., timing) and whether sleep's influence differs in teens who self-report learning/behavior problems (e.g., ADHD). These nationwide data further underscore the importance of considering sleep as educators and policy makers determine school schedules.

Support (if any):

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ADOLESCENT SLEEP VARIABILITY, SOCIAL JETLAG, AND MENTAL HEALTH DURING COVID-19: FINDINGS FROM A LARGE NATIONWIDE STUDY

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Introduction: Adolescents are vulnerable to short, insufficient sleep stemming from a combined preference for late bedtimes and early school start times, and also circadian disruptions from frequent shifts in sleep schedules (i.e., social jetlag). These sleep disruptions are associated with poor mental health. The COVID-19 pandemic has impacted education nationwide, including changes in instructional formats and school schedules. With data from the Nationwide Education and Sleep in TEens During COVID (NESTED) study, we examined whether sleep variability and social jetlag (SJL) during the pandemic associate with mental health.

Methods: Analyses included online survey data from 4767 students (grades 6-12, 46% female, 36% non-White, 87% high school). For each weekday, participants identified if they attended school in person (IP), online-scheduled synchronous classes (O/S), online-no scheduled classes (asynchronous, O/A), or no school. Students reported bedtimes (BT) and wake times (WT) for each instructional format and for weekends/no school days. Sleep opportunity (SlpOpp) was calculated from BT and WT. Weekday night-to-night SlpOpp variability was calculated with mean square successive differences. SJL was calculated as the difference between the average sleep midpoint on free days (O/A, no school, weekends) versus scheduled days (IP, O/S). Participants also completed the PROMIS Pediatric Anxiety and Depressive Symptoms Short Form. Data were analyzed with hierarchical linear regressions controlling for average SlpOpp, gender, and school-level (middle vs high school).

Results: Mean reported symptoms of anxiety (60.0 ±9.1; 14%≧70) and depression (63.4 ±10.2; 22%≧70) fell in the at-risk range. Shorter average SlpOpp (mean=8.3±1.2hrs) was correlated with higher anxiety (r=-.10) and depression (r=-.11; p's<.001) T-scores. Greater SlpOpp variability was associated with higher anxiety (B=.71 [95%CI=.41-1.01, p<.001) and depression (B=.67 [.33-1.00], p<.001) T-scores. Greater SJL (mean=1.8±1.2hrs; 94% showed a delay in midpoint) was associated with higher anxiety (B=.36 [.12-.60], p<.001) and depression (B=.77 [.50-1.03], p<.001) T-scores.

Conclusion: In the context of system-wide education changes during COVID-19, students on average reported at-risk levels of anxiety and depression symptoms which were associated with greater variability in sleep opportunity across school days and greater social jetlag. Our findings suggest educators and policymakers should consider these sleep-mental health associations when developing instructional formats and school schedules during and post-pandemic.

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CHANGES IN CHILDREN'S SCHOOLYEAR AND SUMMER SLEEP DURING THE COVID-19 PANDEMIC

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Introduction: In spring 2020, elementary schools closed to minimize the spread of COVID-19. Questionnaire data suggest children's sleep was impacted during the pandemic, yet device-based data (i.e. accelerometry) on this topic is lacking. The purpose of this study was to examine children's sleep during the COVID-19 pandemic (i.e. spring and summer 2020) compared to previous data collected from the same children during each of the two previous years (spring and summer 2018 and 2019).

Methods: 68 children (age = 9.9±1.2 years, 56% Black, 53% male) previously recruited for an observational cohort study wore a Fitbit Charge 2 on their wrist during the spring and summer from 2018-2020 (i.e. six 30-day measurement periods). We used multilevel mixed models to examine how children's sleep patterns changed during the pandemic accounting for previous trajectory (i.e. 2018 to 2019). Models included age, sex, and race as covariates.

Results: Children had an average of 84 nights of sleep data across all six 30-day measurement periods. In the spring of the pandemic, children slept 24.6 minutes more (95%CI = 11.6, 37.5) compared to previous springs. During the pandemic summer, they slept 40.0 minutes more (95%CI = 24.6, 58.5) compared to previous summers. Sleep midpoint was 117.1 minutes later (95%CI = 103.6, 130.6) in the spring during the pandemic and 46.0 minutes later (95% CI = 26.9, 65.2) in the summer during the pandemic compared to previous years. Sleep efficiency improved slightly by 1.3% (95% CI = 0.7, 1.9) and 3.6% (95% CI = 2.7, 4.5) in spring and summer, respectively, during the pandemic compared to previous years.

Conclusion: During the COVID-19 pandemic, children slept longer after accounting for previous developmental trends. Notably, the shift in sleep timing during the pandemic was nearly two hours later in the spring compared to previous years, potentially due to the lack of structure usually provided by school. Later sleep timing is independently associated with poor health behaviors (e.g., nutrition, physical activity, screen time). Future studies should examine if these changes in sleep

persist over time and have potential long-term effects on children's health.
Support (if any): R21HD095164 (PI Weaver) & UofSC COVID-19 Research Initiative Grant (PI Armstrong)

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HABITUAL SLEEP CHANGES FOLLOWING COVID-19 OUTBREAK

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Introduction: The ongoing COVID-19 pandemic emerges as one of the most impressive and strenuous events of the century, with unthinkably huge global effects. We aimed at analyzing if and how does the pandemic affect sleep and related behaviors.
Methods: We reviewed 48,047 nights recorded in the US with the Sleeprate application by 3,381 users during a period of 2 years, December 2018-November 2020. Nightly data included perceived and measured sleep parameters. In addition, users reported their perceived daytime stress and sleepiness. We analyzed the monthly variability of the studied parameters and compared their values during the COVID-19 period of March-November 2020 (CP) with those in the previous corresponding period in 2019, the pre-COVID-19 period (PCP).
Results: Starting March 2020, wake-up time (WUT) was significantly delayed relative to PCP. WUT in April 2020 was the latest (8:06AM±2:12hours, mean±SD, p<.000), being an hour later than in April 2019. This delay started to diminish in June 2020, reaching 7:27AM±2:10 hours by November 2020, which was not significantly higher than during PCP. Bedtime (BT) exhibited similar behavior, yet it returned to PCP times faster. Delayed BT and WUT on weekends were observed during CP as well as PCP. No consistent differences in sleep duration or sleep efficiency were detected between CP and PCP. Subjective sleep satisfaction was higher in CP relative to PCP. However, daytime sleepiness and daytime stress were also higher during most of CP compared to PCP.
Conclusion: Our data, based on digital in-app sleep diaries coupled with perceived sleep parameters, demonstrate the pandemic's effects on sleep behavior in the US. Users in this study adapted to the new circumstances with delayed sleep schedule, while not reducing the sleep opportunity. The higher sleep satisfaction may be connected to later sleep schedules, allowing a wake-up time that fits better human biological clocks. The reported increased stress and sleepiness further portray the uncertainty and turbulence characterizing the pandemic's effects on populations life during the pandemic. As good sleep is linked with immune response efficacy, higher quality of life, and improved mood, the importance of sleep must not be overlooked, especially during the pandemic.
Support (if any):

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REMOTELY DELIVERED YOGA NIDRA FOR INSOMNIA AND ANXIETY DURING COVID-19

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Introduction: Insomnia and related anxiety affect 30 - 50% of the US adult population. These conditions often coexist, and contribute to increased mortality from depression, heart disease, and stroke. The current COVID-19 pandemic has heightened anxiety and sleeplessness, and 53% of US adults report the pandemic has affected their mental health. There is a need for research into therapies for anxiety and insomnia that can be delivered remotely for increased accessibility to reach more individuals in need.
Methods: To contribute to this need, we examined the effects of remotely delivered Yoga Nidra (translated to mean "yogic sleep"), a guided meditation practice, on anxiety and sleep. The practice was delivered in real-time before bed, or asynchronously via an online REDCap-based platform, once per week for 16-weeks from April to July (during the early months of the COVID-19 pandemic).
Results: Seventy-four individuals joined the study, of whom 71% reported subthreshold insomnia (Insomnia Severity Index score of 14 ± 4), and 74% reported anxiety (Generalized Anxiety Disorder Index score of 10 ± 5). Seventy-one (96%) participants accessed the asynchronous recordings. Remote delivery of this practice proved very feasible, with no adverse events reported, and although we provided no monetary compensation, 50% of our sample still completed a post-intervention survey. Further, 52% of n=25 respondents who completed both pre- and post-intervention sleep surveys reported decreased sleep onset latency (SOL) the following day, with a mean decrease of 10 minutes (95% CI = −19.0, −0.5) for all respondents, and strongest change (−34 min; p=.017) measured for those who reported SOL between 30-120 min at baseline. Overall state anxiety was decreased by 41% for n=32 respondents who completed pre-post State Trait Anxiety Index (STAI) surveys surrounding a single practice (average score of 47 ± 11 before practice vs. 27 ± 8 after practice, p<.0001).
Conclusion: Remotely delivered Yoga Nidra is feasible to deliver, and demonstrates potential benefits for anxiety and insomnia, warranting additional research.
Support (if any): This work was supported by the R90 BRIDG grant at the Helfgott Research Institute at the National University of Natural Medicine.

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SUFFICIENT SLEEP ATTENUATES THE IMPACT OF COVID-19 PANDEMIC ON EXECUTIVE FUNCTION DECLINE IN LATE ADOLESCENTS AND YOUNG ADULTS

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Introduction: Executive function (EF), which shows continued development into early adulthood, is essential to build resilience to cope with COVID-19-related social and environmental changes. However, how sleep interacts with the pandemic on affecting EF remains unclear, particularly among late adolescents and young adults. This study examined (1) the impact of COVID-19 pandemic on sleep and EF and (2) whether sleep moderated pandemic-related changes in EF among young people aged 18-21 years old.
Methods: Between April and May 2020, university students with baseline data on sleep and EF (Spring and Fall semesters in 2019) available were invited to this follow-up study. Sleep duration, mid-sleep times, social jetlag (the difference between mid-sleep times on weekdays and weekends) and sleep latency were assessed using 7-day sleep diaries. Participants also completed the Pittsburgh Sleep Quality Index (PSQI), the Morningness/Eveningness Questionnaire, and the Behavior Rating Inventory of Executive function which yielded Global Executive Composite (GEC) scores. Paired t-test and multilevel random-effects models (STATA 16.0) estimated the associations. Covariates in multilevel models included age, sex, race, family income, parental education, COVID status, and health behaviors.
Results: Forty participants (19.25±1.12 years old) had paired data before and during COVID-19 pandemic. Participants slept 24 min longer (t= -2.07, p=0.03) but had increased sleep latency (t=-1.83, p=0.07) during the pandemic compared to pre-COVID baseline. Mid-sleep

times shifted 40 min later (t= -3.22, p=0.003) during the pandemic. In multilevel models, GEC scores increased during pandemic (b=3.15, p=0.03) versus baseline, suggesting decreased executive function. Sleep duration (β=-4.72, p=0.03) significantly interacted with assessment time (before/during COVID-19), with increasing sleep duration attenuating the decline in EF during pandemic versus baseline. Although there was no interaction with COVID-19 pandemic, poor sleep quality (PSQI>5) was independently associated with decreased EF (B=4.69, p=0.02). Other sleep variables were not associated with EF nor moderators.

Conclusion: Compared with pre-COVID-19 baseline, young people report longer sleep duration, later sleep phase, increased sleep latency, and worse executive function during the pandemic. Sufficient sleep represents a resilience factor against executive function decline during this unprecedented crisis.

Support (if any): No

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ADVERSE RELATIONSHIPS BETWEEN SLEEP APNEA, WHITE MATTER INTEGRITY AND PERFUSION IS ATTENUATED IN MORE PHYSICALLY FIT OLDER ADULTS

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Introduction: White matter (WM) integrity declines with age and is sensitive to vascular risk modifiers, such as exercise. Sleep apnea is believed to contribute to cerebral white matter change via intermittent hypoxia-induced alterations to cerebral blood flow resulting in cerebrovascular shearing. Existing literature highlights the relationships between poor sleep and numerous adverse health outcomes, including risk for cardiovascular disease and dementia. Conversely, exercise seems to have a positive effect on both brain structure and function. Here we examine a potential interaction between sleep apnea severity and cardiorespiratory fitness (characterized by a gender-specific Non-Exercise CardioRespiratory Fitness Measure, NECRFM) as predictors of MRI measures of brain WM integrity and cerebral blood flow (CBF) in a sample of non-demented older adult participants of the Wisconsin Sleep Cohort (WSC).
Methods: Cross-sectional linear models using data from a subset of 124 WSC participants (50% female; mean age[range]=67.6 [49.6, 85.3]) examined the relationship between sleep apnea severity (apnea-hypopnea index, AHI) and cardiorespiratory fitness in predicting MRI-assessed total WM and lesion volumes, WM hyperintensities (WMHs; a marker of small vessel disease in the brain) and Arterial Spin Labeling (ASL) CBF, controlling for age, sex, BMI, education, and hypertension.
Results: Greater sleep apnea severity was associated more strongly with both total lesion and WMH loads in less fit compared to more fit persons (p's<0.05) in the absence of significant differences in total WM volume. Regional perfusion revealed higher CBF in the angular gyrus, middle frontal cortex, and superior frontal gyrus and lower CBF in the anterior cingulate gyrus and the hippocampus of more fit compared to less fit persons (p's< 0.05), in the absence of differences in mean global perfusion.
Conclusion: Overall, our results suggest that better general fitness may attenuate negative brain health outcomes related to poor sleep. We highlight an important relationship between brain health and modifiable behavioral factors, namely sleep and fitness, that have the potential to help maintain or improve brain integrity with age.
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PHYSICAL FITNESS ATTENUATES THE DELETERIOUS ASSOCIATION OF SLEEP APNEA WITH GRAY MATTER VOLUME IN THE WISCONSIN SLEEP COHORT STUDY

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Introduction: Recent evidence has illustrated that gray matter (GM) atrophy, a diagnostic hallmark of Alzheimer's disease (AD), may be influenced by psychosocial risk modifiers such as physical exercise and sleep. Cardiorespiratory fitness, a measure of oxygen delivery and utilization during exercise, is positively associated with both sleep quality and gray matter volume in brain areas associated with age-related cognitive decline, such as the hippocampus. In contrast, sleep apnea has been linked to global and regional gray matter atrophy, which is thought to be driven in-part by the incomplete modulation of cardiovascular and respiratory control during sleep. This study examines whether cardiorespiratory fitness modifies the deleterious relationship between sleep apnea and GM volume in a sample of non-demented older participants from the Wisconsin Sleep Cohort (WSC).
Methods: Using data from a subset of WSC participants (n=129, 51% female, mean [range] age at baseline=68 [49-85] years), cardiorespiratory fitness was estimated using a Non-Exercise CardioRespiratory Fitness Measure (NECRFM; based on age, sex, BMI, self-reported physical activity, and resting heart rate). Sleep apnea severity was measured by overnight polysomnography and characterized by the base 10 logarithm of the apnea-hypopnea index, log10(AHI+1). We assembled cross-sectional linear models of MRI-measured total GM volume using NECRFM and log10(AHI+1) as predictors while controlling for age, sex, BMI, education, and hypertension. Regional volumetric changes in the hippocampus and amygdala were assessed using analogous linear models, adjusting both outcome volumetrics for total intracranial volume.
Results: While the interaction between fitness and apnea severity was not significant (p=0.50), results stratified at the median NECRFM illustrated that among the less fit individuals, higher log10(AHI+1) was associated with a significant reduction in total GM volume (B(SE)=-0.06 (0.02); p=0.007); this relationship was not significant among those who were more fit (B(SE)=-0.03 (0.02); p=0.11). There were no significant effects in the hippocampus or amygdala.
Conclusion: These results indicate that cardiovascular fitness may attenuate the effect of severe sleep apnea on GM volume in older adults, supporting the protective role of cardiovascular fitness in aging brain health.
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SLEEP AND CORTICAL THICKNESS ARE INFLUENCED BY SURGICAL MENOPAUSE

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Introduction: Early loss of 17β-estradiol (E2), as experienced by women with bilateral salpingo-oophorectomy (BSO; removal of ovaries and fallopian tubes), is associated with increased prevalence of sleep disorders and greater Alzheimer's disease (AD) risk. In older adults, poor sleep heightens AD risk; hypoxia increases markers for incipient AD, including circulating Aβ, and is linked to prefrontal cortical thinning. Thus, we wondered: 1) if this at-risk population of middle-aged women with BSO had sleep hypoxia, measured by oxygen desaturation, and 2) whether this related to decreased prefrontal cortical thickness in women taking and not taking estradiol therapy (ET).
Methods: Sleep and percent oxygen desaturation (SPO2%) were measured via at-home polysomnography (TEMEC). Prefrontal cortical thickness was obtained from T1-weighted structural scans using

the CIVET pipeline. We recruited middle-age women with BSO, some of whom were taking ET (BSO+ET; n=15), and some not (BSO; n=15). We compared their sleep and cortical thickness with that of age and education-matched premenopausal controls (AMC; n=18).

Results: Women with BSO (BSO, BSO+ET) had lower minimum SPO2% values than AMC, and thinner right medial orbitofrontal (rmOF) cortices. There was a trend for women with BSO to have lower average SPO2% than AMC. Analyses separating groups based on ET therapy status (BSO vs BSO+ET vs AMC) revealed only trending differences between groups, such that women with BSO tended to have lower minimum SPO2% and thinner rmOF cortices than AMC.

Conclusion: These preliminary results suggest early loss of E2 due to BSO may drive greater drops in SPO2% in middle-age women, and may be related to reduced prefrontal cortical thickness. This study is the first to show hypoxia in women with BSO.

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MAINTENANCE OF CIRCADIAN/DAILY ACTIVITY PATTERNS AND COGNITIVE RESILIENCE TO ALZHEIMER'S PATHOLOGY IN LATE LIFE

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Introduction: Many individuals remain free from dementia despite substantial plaque and tangle deposits, the hallmarks of Alzheimer's disease (AD). Understanding of this cognitive resilience is poor. Evidence suggests that circadian disturbances predict increased risk of incident AD, and that circadian regulation deteriorates as clinical AD progresses. We hypothesize that circadian robustness protects against dementia, and the effect is stronger in individuals with AD pathology than those without.

Methods: We studied 575 deceased participants (age at death: 91.1□6.2; female: 414) in the Rush Memory and Aging Project who underwent brain autopsy at death, had clinical diagnostic opinion of dementia and motor activity assessments with actigraphy of ~10 days before death. Using actigraphy proximate to death, we calculated four circadian metrics: amplitude, acrophase, interdaily stability, and intradaily variability. Logistic regressions, stratified by postmortem pathologic AD diagnosis, were used to examine associations of circadian metrics with odds of dementia, and separately cognitive impairment (CI, including both dementia and mild cognitive impairment [MCI]), adjusting for age at death, sex, education, and time-lag between actigraphy and death.

Results: Based on postmortem assessment, 378 participants met the NIA-Reagan criteria for high/intermediate likelihood AD (AD group), including 197 clinically diagnosed with dementia, 86 MCI, and 85 cognitively intact. Non-AD group consisted of the remaining 197 participants, including 36 with clinical dementia, 47 MCI, and 114 cognitively intact. In the AD group, greater amplitude, greater interdaily stability, and lower intradaily variability were associated with lower odds of CI and dementia, i.e., odds ratios [OR] for CI corresponding to 1-SD changes were 0.54 (95% CI: 0.40-0.71), 0.70 (0.54-0.91), and 0.63 (0.47-0.84), and were 0.46 (0.35-0.60), 0.55 (0.43-0.70), and 0.61 (0.48-0.78) for dementia. In the non-AD group, only amplitude was associated with the odds of CI or dementia, i.e., the ORs corresponding to 1-SD increase was 0.61 (0.42-0.88) and 0.50 (0.31-0.82), respectively.

Conclusion: Better preserved circadian function, as characterized by more pronounced, more stable and less fragmented rest-activity rhythms, links to lower risk of CI or dementia in older people, especially those with pathological AD.

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AUTOMATED SLEEP STAGING USING WRIST-WORN DEVICE AND DEEP NEURAL NETWORKS

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Introduction: Heart rate is well-known to be modulated by sleep stages. If clinically useful sleep scoring can be performed using only cardiac rhythms, then existing medical and consumer-grade devices that can measure heart rate can enable low-cost sleep evaluations.
Methods: We trained a neural network which uses dilated convolutional blocks to learn both local and long range features of heart rate extracted from ECG R-wave timing to predict for every non-overlapping 30 s epoch of the input the probabilities of the epoch being in one of four classes—wake, light sleep, deep sleep or REM. The largest probability is chosen as the network's class prediction and used to form the hypnogram. We used the Sleep Heart Health Study (SHHS) and Multi-Ethnic Study of Atherosclerosis Study (MESA) and Physionet Computing in Cardiology (CinC) dataset (over 10000 nights) for training and evaluation. Then we deployed the algorithm on PPG based heart rate measured by a wrist-worn device worn by subjects in a free-living setting.
Results: On the held out test SHHS dataset (800 nights, 561 subjects), the overall 4-class staging accuracy was 77% and Cohen's kappa was 0.66. On the CinC dataset (993 nights, 993 subjects), the overall 4 class accuracy was 72% and Cohen's kappa was 0.55. The study on free-living subjects is underway and these novel results will be collated and presented upon completion.
Conclusion: We hope these results build more trust in automated heart rate based sleep staging and encourage further research into its clinical application in screening and diagnosis of sleep disorders. Low cost, high efficacy devices which can be used in longitudinal studies can lead to breakthroughs in clinical applications of sleep staging for early diagnosis of chronic conditions and novel treatment endpoints.
Support (if any): We recently published the training/testing of the algorithm as well a population level analysis showing differences in predicted sleep stages between disease cohorts. The article was published in NPJ Digital Medicine in Aug 2020. The study on free living subjects is currently underway and these new results will be presented at the sleep conference. Preliminary results indicate high concordance with our published results.

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BEHAVIOURAL BIOMETRICS: USING SMARTPHONE KEYBOARD ACTIVITY AS A PROXY FOR REST-ACTIVITY PATTERNS

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Introduction: Rest-activity patterns are important aspects of healthy sleep and may be disturbed in conditions like circadian rhythm disorders, insomnia, insufficient sleep syndrome, and neurological disorders. Long-term monitoring of rest-activity patterns is typically performed with diaries or actigraphy. Here, we propose a fully unobtrusive method to obtain rest-activity patterns using smartphone keyboard activity. This study investigated whether keyboard activities from habitual smartphone use are reliable estimates of rest and activity timing compared to daily self-reports within healthy participants.
Methods: First-year students (n = 51) used a custom smartphone keyboard to passively and objectively measure smartphone use behaviours, and filled out the Consensus Sleep Diary for one week. The time of the last keyboard activity before a nightly absence of keystrokes, and the time of the first keyboard activity following this period were used as markers.
Results: Results revealed high correlations between these markers and user-reported onset and offset of resting period (r ranged 0.74 - 0.80). Linear mixed models could estimate onset and offset of resting periods with reasonable accuracy (R2 ranged 0.60 - 0.66). This indicates that smartphone keyboard activity can be used to estimate rest-activity patterns. In addition, effects of chronotype and type of day were investigated.
Conclusion: Implementing this monitoring method in longitudinal studies would allow for long-term monitoring of (disturbances to) rest-activity patterns, without user burden or additional costly devices. It could be particularly useful in studies amongst clinical populations with sleep-related problems, or in populations for whom disturbances in rest-activity patterns are secondary complaints, such as neurological disorders.
Support (if any):

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OVERNIGHT HEART RATE VARIABILITY DEPENDS ON AGE, GENDER, AND DAY OF THE WEEK: A FIELD OBSERVATION USING A SMART BED PLATFORM

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Introduction: Heart rate variability (HRV) is commonly used to assess the activity of the autonomic nervous system (ANS). ANS function changes, reflected in HRV, result from factors including lifestyle, aging, cardiorespiratory illnesses, sleep state, and physiological stress. Despite broad interest in HRV, few studies have established normative overnight HRV values for a large population. To better understand population level HRV changes, ecologically-valid, overnight sleep SDNN (standard deviation of all normal heartbeat intervals, lower HRV is reflected by lower SDNN) values have been analyzed for a large sample of Sleep Number 360 smart bed users.
Methods: Overnight SDNN values were obtained over the course of 18.2M sleep sessions from 379,225 sleepers (48 ± 14.7 sessions/user). 50.9 percent of sleepers were female. The age was normally distributed with mean ± SD of 52.8 ± 12.7 years (range 21 to 84). Heartbeat intervals used to compute SDNN were extracted from a ballistocardiogram (BCG). BCG-based HRV estimation during sleep has previously been validated against ECG-based HRV with an R-square of 0.5.
Results: Using a Generalized Linear Model, significant cross-sectional associations with SDNN were observed for three variables of interest: age, gender, and day-of-the-week. For sleepers under 50, SDNN declined at a rate of about 2.1 ms/year, then leveled off for sleepers aged 50-65, and increased slightly thereafter. Women under 50 displayed lower, more slowly declining, SDNN values than men, but this trend reversed for sleepers over 50. Throughout the week, SDNN values followed a U-shaped (women) or L-shaped (men) pattern, where values were highest during the weekend and lowest at mid-week.
Conclusion: Using a smart bed to unobtrusively measure overnight SDNN values for a large set of sleepers in an ecologically valid environment, reveals significant effects of age, gender, and day of the week on overnight SDNN.
Support (if any):

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AI-SUPPORTED SLEEP STAGING FROM ACTIVITY AND HEART RATE

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Introduction: Polysomnography (PSG) is considered the gold standard for sleep staging but is labor-intensive and expensive. Wrist wearables are an alternative to PSG because of their small form factor and continuous monitoring capability. In this work, we present a scheme to perform such automated sleep staging via deep learning in the MESA cohort validated against PSG. This scheme makes use of actigraphic activity counts and two coarse heart rate measures (only mean and standard deviation for 30-s sleep epochs) to perform multi-class sleep staging. Our method outperforms existing techniques in three-stage classification (i.e., wake, NREM, and REM) and is feasible for four-stage classification (i.e., wake, light, deep, and REM).
Methods: Our technique uses a combined convolutional neural network coupled and sequence-to-sequence network architecture to appropriate the temporal correlations in sleep toward classification. Supervised training with PSG stage labels for each sleep epoch as the target was performed. We used data from MESA participants randomly assigned to non-overlapping training (N=608) and validation (N=200) cohorts. The under-representation of deep sleep in the data leads to class imbalance which diminishes deep sleep prediction accuracy. To specifically address the class imbalance, we use a novel loss function that is minimized in the network training phase.
Results: Our network leads to accuracies of 78.66% and 72.46% for three-class and four-class sleep staging respectively. Our three-stage classifier is especially accurate at measuring NREM sleep time (predicted: 4.98 ± 1.26 hrs. vs. actual: 5.08 ± 0.98 hrs. from PSG). Similarly, our four-stage classifier leads to highly accurate estimates of light sleep time (predicted: 4.33 ± 1.20 hrs. vs. actual: 4.46 ± 1.04 hrs. from PSG) and deep sleep time (predicted: 0.62 ± 0.65 hrs. vs. actual: 0.63 ± 0.59 hrs. from PSG). Lastly, we demonstrate the feasibility of our method for sleep staging from Apple Watch-derived measurements.
Conclusion: This work demonstrates the viability of high-accuracy, automated multi-class sleep staging from actigraphy and coarse heart rate measures that are device-agnostic and therefore well suited for extraction from smartwatches and other consumer wrist wearables.
Support (if any): This work was supported in part by the NIH grant 1R21AG068890-01 and the American Association for University Women.

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AGREEMENT AND RELIABILITY OF A NEW POLYSOMNOGRAPHY SLEEP STAGING ALGORITHM AGAINST MULTIPLE HUMAN SCORERS

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Introduction: Scoring algorithms have the potential to increase polysomnography (PSG) scoring efficiency while also ensuring consistency and reproducibility. We sought to validate an updated sleep staging algorithm (Somnolyzer; Philips, Monroeville PA USA) against manual sleep staging, by analyzing a dataset we have previously used to report sleep staging variability across nine center-members of the Sleep Apnea Global Interdisciplinary Consortium (SAGIC).
Methods: Fifteen PSGs collected at a single sleep clinic were scored independently by technologists at nine SAGIC centers located in six countries, and auto-scored with the algorithm. Each 30-second epoch was staged manually according to American Academy of Sleep Medicine criteria. We calculated the intraclass correlation coefficient (ICC) and performed a Bland-Altman analysis comparing the average manual- and auto-scored total sleep time (TST) and time in each sleep stage (N1, N2, N3, rapid eye movement [REM]). We hypothesized that the values from auto-scoring would show good agreement and reliability when compared to the average across manual scorers.
Results: The participants contributing to the original dataset had a mean (SD) age of 47 (12) years and 80% were male. Auto-scoring showed substantial (ICC=0.60-0.80) or almost perfect (ICC=0.80-1.00) reliability compared to manual-scoring average, with ICCs (95% confidence interval) of 0.976 (0.931, 0.992) for TST, 0.681 (0.291, 0.879) for time in N1, 0.685 (0.299, 0.881) for time in N2, 0.922 (0.791, 0.973) for time in N3, and 0.930 (0.811, 0.976) for time in REM. Similarly, Bland-Altman analyses showed good agreement between methods, with a mean difference (limits of agreement) of only 1.2 (-19.7, 22.0) minutes for TST, 13.0 (-18.2, 44.1) minutes for N1, -13.8 (-65.7, 38.1) minutes for N2, -0.33 (-26.1, 25.5) minutes for N3, and -1.2 (-25.9, 23.5) minutes for REM.
Conclusion: Results support high reliability and good agreement between the auto-scoring algorithm and average human scoring for measurements of sleep durations. Auto-scoring slightly overestimated N1 and underestimated N2, but results for TST, N3 and REM were nearly identical on average. Thus, the auto-scoring algorithm is acceptable for sleep staging when compared against human scorers.
Support (if any): Philips.

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NON-INVASIVE QUANTIFICATION OF HUMAN BRAIN LACTATE CONCENTRATIONS ACROSS SLEEP-WAKE CYCLES

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Introduction: Cellular mechanisms underlying changes in small animal brain lactate concentrations have been investigated for more than 70 years and report sharp reductions in lactate (12-35%) during sleep or anesthesia relative to wakefulness. The goal of this study was to investigate alterations in human cerebral lactate concentrations across sleep-wake cycles. Toward this goal, we developed a novel non-invasive methodology, quantified changes in human cerebral lactate during sleep stages, and investigated potential mechanisms associated with changes in lactate.
Methods: Nine subjects (four females, five males; 21-27 y-o, mean age 24.2 ±2) were sleep deprived overnight, and underwent (5:45~11:00 am) experiments combining simultaneous MR-spectroscopy (MRS) and polysomnography (PSG) in a 3 T MR instrument using a 64-channel head/neck coil. A single voxel MRS (1H-MRS) acquired signals from a volume of interest (12~24 cm3) for every 7.5-s for 88~180-min. Lactate signal intensity was determined from each 7.5-s spectrum, normalized to corresponding water signal, and averaged over 30-s for each PSG epochs. Artifact corrected PSG data were scored for each

30-s epoch using the standard criteria and classified into one of four stages: W, N1, N2 and N3. Group mean lactate levels were quantified using LCModel. Three subjects returned for lactate diffusivity measurements using diffusion-sensitized PRESS MRS sequence.
Results: Compared to W, group mean lactate levels within each sleep stage showed a reduction of [4.9 ± 4.9] % in N1, [10.4 ± 5.2] % in N2, and [24.0 ± 5.8] % in N3. We observed a significant decrease in lactate apparent diffusion coefficient (ADC) accompanied by reduced brain lactate in sleep compared to wake (P<0.002). There were no differences in ADC values between wake and sleep for H2O, NAA, tCr, or Cho.
Conclusion: This is the first in-vivo report of alterations in human brain lactate concentrations across sleep-wake cycles. Observed decline in lactate levels during sleep compared to wakefulness is consistent with, and extends results from invasive small animal brain studies first reported more than 70 years ago, and support the notion of altered lactate metabolism and/or increased glymphatic activity in sleeping human brain.
Support (if any): The Paul. G. Allen Family Foundation funded the study.

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BETTER AND FASTER AUTOMATIC SLEEP STAGING WITH ARTIFICIAL INTELLIGENCE

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Introduction: Sleep staging of polysomnography (PSG) is a time-consuming task, it requires significant training, and significant variability among scorers is expected. A new software (MEBsleep by Medibio Limited) was developed to automatically perform sleep scoring based on machine learning algorithms. This study aimed to perform an extensive investigation of its agreement with expert sleep technicians.
Methods: Forty polysomnography recordings of patients that were referred for sleep evaluation to three sleep clinics were retrospectively collected. Three experienced technicians independently staged the recording complying with the scoring rules of the American Academy of Sleep Medicine guidelines. Positive Percent Agreement (PPA), Positive Predictive Value (PPV), and other agreement statistics between the automatic and manual staging, among the staging performed by the three technicians, and their differences were calculated. Bootstrap resampling was used to calculate 95% confidence intervals and statistical significance of the differences.
Results: Automatic staging took less than two minutes per PSG on a consumer laptop. The automatic staging resulted for the most comparable (PPA difference of N1, N3, and REM; PPV difference of N1, N2, N3, and REM) or statistically significantly more in agreement with the technicians' staging than the between-technician agreement (PPA difference of N2: 3.90%, 95% bootstrap CI 1.79%-6.01%; PPV difference of Wake: 1.16%, 95% bootstrap CI 0.64%/1.67%), with the sole exception of a partial reduction in the positive percent agreement of the Wake stage (PPA difference of Wake -7.04%, 95% bootstrap CI -10.40%/-3.85%). The automatic staging also demonstrated very high accuracy in an indirect comparison with other similar software.
Conclusion: Given these promising results, the use of this software may support sleep clinicians by improving efficiency in sleep scoring.
Support (if any):

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VALIDATION OF A NON-WEARABLE SLEEP TRACKING DEVICE IN HEALTHY ADULTS UNDER NORMAL AND RESTRICTED SLEEP CONDITIONS

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Introduction: Polysomnography (PSG) is the gold standard for measuring sleep, but this method is cumbersome, costly, and sometimes does not reflect naturalistic sleep patterns. Leading technology companies have developed non-wearable sleep tracking devices that have attracted public interest. However, the accuracy of these devices has either been shown to be poor or the validation tests have not been conducted by independent laboratories without potential conflicts of interest. Relative to PSG and actigraphy, and under conditions of both normal and restricted sleep, we assessed the accuracy of early and newer versions of a non-wearable sleep tracking device (Beddit, Apple Inc.).
Methods: Participants were 35 healthy young adults (Mage=18.97, SD=0.95 years; 77.14% female; 42.86% Caucasian). We randomly assigned them to go to bed at 10:30pm (normal sleep) or 1:30am (restricted sleep) in a controlled sleep laboratory environment. Lights-on was 7:00am for all participants. Sleep was measured by the early version (3.0) or newer version (3.5) of a non-wearable device that uses a sensor strip to measure movement, heart rate, and breathing. We also measured PSG, wristband actigraphy, and self-report. For each device, we tested accuracy against PSG for total sleep time (TST), sleep efficiency (SE%), sleep onset latency (SOL), and wake after sleep onset (WASO).
Results: While the early version displayed poor reliability (ICCs<0.30), the newer version of the non-wearable device yielded excellent reliability with PSG under both normal and restricted sleep conditions. Not only was agreement excellent for TST (ICC=0.96) and SE% (ICC=0.98), but agreement was also excellent for the notoriously difficult metrics of SOL (ICC=0.92) and WASO (ICC=0.92). This newer version significantly outperformed clinical grade actigraphy (ICCs often in the 0.40 to 0.75 range), and self-reported sleep (ICCs often below 0.40).
Conclusion: Surprisingly, a non-wearable device demonstrated greater agreement with PSG than clinical grade actigraphy. Though the field has generally been skeptical of commercial non-wearable devices, this independent validation provides optimism that some such devices would be efficacious for research in healthy adults. Future work is needed to test the validity of this device in older adults and clinical populations.
Support (if any): National Science Foundation (1920730 and 1943323)

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SPECTROPHOTOMETRIC PROPERTIES OF COMMERCIAL BLUE-BLOCKING LENSES IN SUNLIGHT

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Introduction: Blue-blocking glasses are increasingly used as an intervention for jet-lag and other situations where an individual wishes to promote a "dark" signal despite the presence of ambient light. However, most studies on blue-blockers are done under controlled laboratory settings using emissions generated from electric light sources. The present study evaluated the performance of commercially available blue-blockers under daytime sunlight conditions.

Methods: A calibrated spectroradiometer (Ocean Insight), cosine corrector, optic fiber, and software package were used to measure the absolute irradiance (uW/cm^2/nm) available midday in a standardized location that received direct sunlight. Thirty-one commercially available blue-blockers were individually placed in front of the cosine corrector and intensity was measured and analyzed. Each lens was tested for its ability to block visible light, as well as light within the 440-530nm range. Lenses were evaluated individually and grouped by lens type: red-tinted lenses (RTL), orange-tinted lenses (ORL), orange-tinted lenses with blue reflectivity (OBL), brown-tinted lenses (BTL), yellow-tinted lenses (YTL), and clear lenses with blue reflectivity (RBL).
Results: Across the full spectrum, RTL blocked 66% of the light, OTL blocked 60%, OBL blocked 43%, BTL blocked 56%, YTL blocked 28%, and RBL blocked 20%. When the range was restricted to 440-530nm, RTL blocked 99%, OTL blocked 96%, OBL blocked 90%, BTL blocked 66%, YTL blocked 38%, and RBL blocked 17% of the light. Variation across lens types was significant for the full spectrum (one-way ANOVA, $p < 0.0001$) as well as the 440-530nm range (one-way ANOVA, $p < 0.0001$). Individual lenses showed variability in performance, though this variability was smaller than the between-group differences.
Conclusion: Under daylight conditions, red and orange lenses (RTL, OTL, and OBL) blocked at least 90% of the light in the 440-530nm range. Notably, RBL lenses restricted the most short-wavelength light as a proportion of the total light blocked. These data suggest that RTL, OTL, and OBL are effective at blocking the most circadian photosensitive components of daylight at the cost of reducing total illumination.
Support (if any): R01MD011600, R01DA051321

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SPECTROPHOTOMETRIC PROPERTIES OF 31 DIFFERENT COMMERCIALLY AVAILABLE BLUE BLOCKING GLASSES UNDER ELECTRIC ROOM LIGHTING

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Introduction: Blue blocking glasses are often marketed to promote relaxation, sleep, and circadian health by attenuating melatonin-suppressing light exposure. But these glasses represent a wide range of tint and other lens properties. Further, the utility of these glasses under ecologically valid indoor conditions (where light is typically generated from overhead broadspectrum fluorescent lamps) is still unclear, especially across various products.
Methods: A calibrated spectroradiometer (Ocean Insight), cosine corrector, optic fiber, and software package were used to measure the absolute irradiance (uW/cm^2/nm) emitted from overhead fluorescent lighting in a closeted dark room. Thirty-one commercially available blue blockers were individually placed between the cosine corrector and the luminaire, at a standardized distance and angle, where intensity was measured and analyzed. Each lens was evaluated individually relative to the light source under identical conditions. Then, lenses were collapsed by type into the following groups: red-tinted lenses (RTL), orange-tinted lenses (OTL), orange-tinted lenses with blue reflectivity (OBL), brown-tinted lenses (BTL), yellow-tinted lenses (YTL), and clear reflective blue lenses (RBL).
Results: There was significant variation in light-blocking across lens types (one-way ANOVA, $p < 0.0001$). On average, RTL and BTL restricted 59% of the visible light measured from 380-780nm. OTL blocked 47% of the light in this range, while OBL blocked 29%. Both YTL and RBL blocked 14% of the exposure. When narrowing the range of light to 440-530nm (the part of the spectrum most likely to produce a response from melanopsin-expressing retinal ganglion cells), we estimated the following performance: the RTL and OTL blocked close to 100% of the light, OBL blocked 98%, BTL blocked 80%, YTL blocked 33%, and RBL blocked 15%. These differences were statistically significant (one-way ANOVA, $p < 0.0001$). Individual lenses performed variably within groups, but these differences were small.
Conclusion: Focusing on the portion of the visible spectrum most likely to suppress melatonin secretion, RTL and OTL blocked exposure the best, followed by OBL, BTL, YTL, and (lastly) RBL.
Support (if any): R01MD011600, R01DA051321

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HOW MUCH BLUE DO BLUE-BLOCKERS BLOCK IF BLUE-BLOCKERS DO BLOCK BLUE?

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Introduction: Short-wavelength light (440-530nm) can suppress endogenous melatonin secretion from the pineal gland. This has been observed in realworld settings when people use electronic media at night that emits light from this part of the visible spectrum. Blue-blocking glasses are a possible intervention to reduce blue light exposure. The present study evaluated the ability of commercially available blue-blockers to block blue light emitted by LEDs.
Methods: A calibrated spectroradiometer (Ocean Insight), cosine corrector, optic fiber, and software package were used to measure the absolute irradiance (uW/cm^2/nm) generated from a blue light source (Phillips Go Lite Blu) in an otherwise completely dark room. Thirty-one different commercially-available blue-blockers were individually placed between the cosine corrector and the light source at a standardized distance, and then intensity was measured and analyzed. Lenses were evaluated with regards to the amount of blue light they suppressed both individually and grouped by lens tint: red-tinted lenses (RTL), orange-tinted lenses (OTL), orange-tinted lenses with blue reflectivity (OBL), brown-tinted lenses (BTL), yellow-tinted lenses (YTL), and clear lenses with blue reflectivity (RBL).
Results: RTL blocked 100% of the short-wavelength light, while OTL and OBL blocked 99%, BTL blocked 66%, YTL blocked 38%, and RBL blocked 11% of it. This represented a statistically significant between-group difference (one-way ANOVA, < 0.0001). Within groups, there was variability in performance among individual lenses, though this variability was small compared to the between-group differences.
Conclusion: The RTL, OTL, and OBL block light best capable of suppressing melatonin secretion at night (440-530 nm); with slightly less efficacy, BTL and YTL also restricted much of the light exposure. Lastly, RBL were not effective at curtailing short-wavelength light. Those looking to optimize blue-blocking capabilities should use RTL, OTL, and OBL, rather than other lens types.
Support (if any):

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BLUE BLOCKERS' ABILITY TO BLOCK CIRCADIAN-ACTIVE LIGHT EMITTED FROM A TABLET

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Introduction: Short-wavelength light emitted from electronic devices in the evening can harm circadian health by suppressing endogenous

melatonin and phase-delaying the timing of the wake-sleep cycle. Blue-blocking glasses are one possible intervention to reduce this exposure. The present study evaluated the differential ability of commercially available blue-blockers to filter out the blue range of visible-spectrum light emitted by a common electronic device.

Methods: A calibrated spectroradiometer (Ocean Insight), cosine corrector, optic fiber, and software package were used to measure the absolute irradiance (uW/cm^2/nm) emitted from a commercially-available computer tablet (iPad) displaying a blank white screen in a closeted dark room. Thirty-one commercially-available blue-blockers were individually placed between the cosine corrector and the tablet. At a standardized distance and angle, the resulting intensity profile was measured and analyzed. Each lens was evaluated individually relative to the light source and then evaluated across subtypes, including red-tinted lenses (RTL), orange-tinted lenses (OTL), orange-tinted lenses with blue reflectivity (OBL), brown-tinted lenses (BTL), yellow-tinted lenses (YTL), and clear reflective blue lenses (RBL).

Results: There was significant variation in tablet-generated light-blocking across the full spectrum (one-way ANOVA, $p < 0.0001$) and for the 440-530nm range in particular (one-way ANOVA, $p < 0.0001$). RTL blocked 99%, OTL blocked 81%, OBL blocked 75%, BTL blocked 83%, YTL blocked 33%, and RBL blocked 17% of broadspectrum light (380-780nm). In the 440nm-530nm range, RTL, OTL, and OBL blocked 100% of the emission, while BTL blocked 81%, YTL blocked 47%, and RBL blocked 18% of it.

Conclusion: When using a popular tablet device, RTL, OTL and OBL blocked the most circadian photosensitive parts of the light exposure, indicating they can best preserve the timing of endogenous melatonin secretion in the presence of tablet light at night. By contrast, RBL demonstrated very little efficacy.

Support (if any): R01MD011600, R01DA051321

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TRACKING NATURALISTIC SLEEP OVER THE MENSTRUAL CYCLE WITH A WEARABLE IN HEALTHY YOUNG WOMEN.

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Introduction: A woman's menstrual cycle is characterized by hormonal changes that might affect sleep and therefore daily functionality. While some studies using self-reports have shown a lower sleep quality in the peri-menstruation phase, objective – in lab – studies have not found significant differences in sleep continuity during the menstrual cycle, but are limited by only a few recordings across the cycle. The aim of this study is to examine changes in sleep during the healthy menstrual cycle using a multi-sensory wearable, allowing continuous, objective, reliable and ecologically valid measurement.

Methods: 12 healthy young women (28.14 ± 2.33) were monitored using Oura ring – a sleep and activity tracker – during an entire menstrual cycle. Participants also reported mood, readiness, and sleep quality using a diary. Four phases of the menstrual cycle were compared (menstruation, periovulation, mid-luteal, and late-luteal). Ovulation day was determined using a urinary luteinizing hormone test.

Results: Ovulatory cycles were confirmed by the Oura ring, which showed a significant increase in average nocturnal heart rate and skin temperature during the post-ovulatory luteal phase relative to menstruation and periovulation. Oura ring measures of sleep continuity (Sleep Onset Latency, Wake After Sleep Onset) and self-reported sleep quality did not change across the 4 menstrual phases. We observed a trend for objective sleep duration, which tended to be shorter in the mid-luteal and late-luteal phases. We also observed a small reduction in perceived readiness and mood during these two phases.

Conclusion: Physiological changes (increase in heart rate and body temperature) in the postovulatory phase of the menstrual cycle are detectable with the Oura ring. Sleep features remain quite stable during the healthy, ovulatory menstrual cycle, apart from a trend for slightly shorter sleep duration in the post-ovulatory phases. In comparison to self-reports, which rely on retrospective memory and might be biased by perception and mood, wearable technologies seem to be a sensitive and informative tool to track sleep and physiological changes during the menstrual cycle.

Support (if any): Supported by RF1AG061355 (Baker/Mednick)

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BEYOND VALIDATION TESTING: A SLEEP TRACKER FOR LONGITUDINAL DATA COLLECTION IN OPERATIONAL ENVIRONMENTS

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Introduction: Sleep tracking wearables are increasingly being validation tested against polysomnography (PSG) and actigraphy, but they may not be ideal for long-term epidemiological sleep studies, or for use in operational environments. A given device's short battery life, limited data storage capacity, inability to detect naps or estimate sleep architecture, or privacy concerns may discourage researchers from using wearables to collect objective sleep data in real-world settings. The Zulu watch (Institutes for Behavior Resources) is designed to collect longitudinal sleep data in operational populations with irregular sleep patterns, such as long-haul pilots or shift workers. It is capable of on-wrist sleep-wake determination, nap detection, on-wrist sleep depth scoring (i.e., interrupted sleep, light sleep, or deep sleep), on-wrist data storage up to 80 sleep intervals, and year-long battery life. Laboratory testing is an important initial step toward establishing the performance of a device for longitudinal real-world sleep evaluation; therefore, the Zulu watch sleep tracking was subjected to testing against gold-standard PSG and actigraphy.

Methods: Eight healthy young adult participants (30.4±3.2 years; mean±SD) wore a Zulu watch and Philips Respironics Actiwatch 2 simultaneously over a 3-day laboratory PSG sleep study, with 8 hours time-in-bed each night. Overall epoch-by-epoch agreement of sensitivity (for sleep), specificity (for wake), and accuracy of Zulu watch data were tested against PSG and Actiwatch 2.

Results: Compared with either PSG or actigraphy, both accuracy and sensitivity for Zulu watch sleep-wake determination were >90% while specificity was low (~26% vs. PSG, ~33% vs. actigraphy). Accuracy for sleep scoring vs. PSG was ~87% for interrupted sleep, ~52% for light sleep, and ~49% for deep sleep.

Conclusion: The Zulu watch showed mixed results but may be a viable candidate for sleep evaluation based on initial laboratory performance testing in healthy adults. The next steps will be to compare the Zulu watch against self-report of sleep in operational and substance use disorder populations. Longitudinal epidemiological sleep studies can become more feasible if technology is tailored to the specific needs of the real-world environment.

Support (if any): Medical Technology Enterprise Consortium award MTEC-17-08-Multi-Topic-0104; Office of Naval Research, Code 34.

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ACCELEROMETER-DERIVED SLEEP AND CIRCADIAN DOMAINS AND SOCIODEMOGRAPHIC CORRELATES IN THE UK BIOBANK

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Introduction: Sleep health encompasses sleep regularity, duration, timing, efficiency and satisfaction. Accelerometry is an established method to estimate sleep in ecologically valid contexts, capturing key characteristic of rest-activity patterns, and facilitating population sleep health research. While hundreds of traits can be generated from open-source algorithms applied to raw acceleration data, the lack of clarity around their meaningful use beyond conventional measures limit the ability of these data to systematically inform evidence-based practices promoting sleep health. Here, we propose a method to identify key sleep and circadian domains, using data reduction methods for hundreds of accelerometer-derived traits to inform population-based sleep heath research. We also aimed to validate our findings by assessing whether the identified domains captured known sociodemographic associations.
Methods: We analyzed sociodemographic and raw triaxial accelerometer data recorded for 7 days from 79,876 adults (mean age 56.3±2.1 years, 56.3% women) participating in the UK Biobank. Standardized data processing using the open-source package GGIR (v1.7-1) resulted in the generation of 107 sleep and circadian traits. Variable clustering was used to identify key sleep and circadian domains, pertinent to sleep health, representing interpretable biological constructs minimizing correlation with other domains. Associations between identified domains and sociodemographic factors were evaluated using general linear models, and clinically significant differences were determined by standardized mean differences (SMD) ≥0.3.
Results: We identified 25 sleep and circadian domains explaining ≥80% of the variability of all 107 included traits. Domains capturing measures of variability tended to cluster together. The most clinically significant associations with sociodemographic characteristics were: women (vs. men) had higher sleep efficiency and lower accumulation of diurnal sleep periods; older (vs. younger) individuals had earlier most active starting time, lower acceleration amplitude and lower number of nocturnal sleep periods; and shift (vs. non-shift) workers had higher variability in sleep timing on weekends.
Conclusion: We demonstrate that variable clustering on accelerometer-derived data can identify meaningful sleep and circadian domains. In addition, identified domains captured known sociodemographic associations commonly observed in the sleep and circadian literature, suggesting that they could be relevant to inform public health practices that promote sleep health.
Support (if any): NHLBI 5R01HL143790-02(PG); NIMHHD R01MD012734(FP); NIDA R01DA051321(FP); NIH/NHLBI K01HL 123612(JM)

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COMPARING TWO METHODS FOR SCORING WRIST ACTIGRAPHY TO POLYSOMNOGRAPHY FOR ESTIMATING TOTAL SLEEP TIME IN HEALTHY MEN

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Introduction: This analysis assessed whether manually setting rest (i.e., time in bed) intervals prior to using a proprietary software package (Actiware, version 6.09) to analyze wrist actigraphy data improved estimates of total sleep time (TST) compared to polysomnography (PSG).
Methods: The Phillips Actiwatch 2 and PSG (reference method) were used to calculate TST on two separate nights in twelve men (age=28.3 ± 5.7). Participants had an 8-hour sleep opportunity on night one and a 5-hour sleep opportunity and on night two. Estimates of TST from actigraphy data were calculated using two scoring methods. For scoring method 1, we allowed the software to automatically choose rest intervals and then applied a proprietary algorithm to calculate TST. For scoring method 2, we manually entered rest intervals using a published decision tree that incorporates activity, light, event marker, and sleep diary data. After the rest intervals were set in method 2, the proprietary algorithm was applied to calculate TST. Mean bias and limits of agreement (LOA) from Bland-Altman plots compared TST derived from both actigraphy scoring methods to PSG estimates.
Results: On night 1 (n=8) TST measured by PSG was 398.4 ± 40.6 minutes, compared to 395.5 ± 70.9 minutes using actigraphy scoring method 1 and 396 ± 44.5 minutes using scoring method 2. Mean bias was similar when comparing both scoring methods to PSG, but the LOA were wider in method 1 compared to method 2 (method 1 vs. PSG: -2.9 [-110.4, 104.7]; method 2 vs. PSG: -2.4 [-66.5, 61.7]; minutes). On night 2 (n=12) TST determined by PSG was 283.3 ± 11.2 minutes, compared to 302.1 ± 84.4 minutes using actigraphy scoring method 1 and 273.1 ± 14.5 minutes using scoring method 2. Again, LOA for TST estimated by actigraphy scoring method 1 were wider compared to scoring method number 2 (method 1 vs. PSG: 18.8 [-136.9, 174.6]; method 2 vs. PSG: -10.2 [-35.1, 14.8]).
Conclusion: These data demonstrate that applying a decision tree to manually set time in bed intervals prior to running analyses in the software results in better agreement when estimating TST from wrist actigraphy compared to PSG.
Support (if any): UL1RR025780, K23AR070275.

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USE OF AN AIR PURIFIER IN THE BEDROOM IMPROVES OBJECTIVE AND PERCEIVED SLEEP

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Introduction: This study examined if an air purifier in the bedroom would improve sleep on a broad sample of healthy people (non-smokers without allergies) with sub-optimal sleep living in urban and suburban areas. This way of testing has the advantage of providing insight into the effectiveness of a product under real-life conditions, yielding more ecologically valid results.
Methods: 36 adults whose objective data indicated suboptimal sleep participated in an 8-week field study. A within subjects, pre-post intervention design was implemented, comparing 4 weeks of nightly product use to 4 weeks without using the product. Intervention consisted of the use of an Alen BreatheSmart 45i air purifier in the bedroom for 24 hours a day during the duration of the intervention period. Sleep was measured objectively with SleepScore Max every night and by self-report. Multilevel regression and paired t-tests were used to test for statistical significance.
Results: Across all participants there were 1591 nights of tracked sleep. Participants (55% male, age 25-74, avg. 44) showed improvement in both objective and perceived sleep during the intervention. While using the air purifier, there was a small but significant improvement

in objective sleep quality (p<.05). In the subgroup of participants who had the poorest objective sleep at baseline (n=16), there were significant improvements while using the air purifier, reflecting improved sleep continuity after falling asleep: fewer awakenings during the night, decreased time awake during the night, increased sleep efficiency, and increased sleep maintenance (all ps<.05). Self-report data showed that, when using the air purifier, participants felt they fell asleep faster, woke up fewer times, spent less time awake at night, and were better able to sleep through the night. In the morning, they were more likely to feel well-rested. They also felt satisfied with their sleep more often and had better sleep quality (all ps<.05).
Conclusion: Using the air purifier in the bedroom can improve sleep. Objectively measured sleep improvement supported self-reported sleep improvements, especially in the subset of participants who showed compromised sleep at baseline.
Support (if any): Alen Corporation

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FIELD TEST OF SOUND MACHINE SHOWS SIGNIFICANT IMPROVEMENT IN PERCEIVED SLEEP BUT NOT OBJECTIVE SLEEP

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Introduction: Ambient sound can mask external environmental noise, reducing sleep disturbances. Recently there has been a call for research with objective sleep measures examining noise as a sleep aid. This study investigated whether using a sound machine (Sound+Sleep SE) would improve sleep in healthy adults whose objective sleep data indicated difficulty falling asleep or waking up frequently during the night. In-home field testing provides insight into the effectiveness of sleep products under real-life conditions, yielding more ecologically valid results.
Methods: A within-subjects, pre-post intervention design was implemented, comparing a 2-week baseline period to 2 weeks of nightly product use. Participants (n=30) measured their sleep nightly using SleepScore by ResMed technology. Sleep experience questionnaires were completed before and after product use. Participants were instructed to use their preferred settings and sound options for the duration of the product use period and to refrain from using other types of sounds for sleep. Multilevel regression and paired t-tests were used to test for statistical significance.
Results: Across participants (63% male; age 28-72, avg. 53), there were 725 nights of tracked sleep. Multilevel analyses revealed no significant differences in objectively-measured sleep outcomes. However, improvements were seen in many aspects of self-reported sleep while using the sound machine: 30% decrease in perceived minutes to fall asleep (p<.05); 76% increase in perceived ability to sleep through the night (p<.001); 37% increase in perceived sleep quality (p<.01); and 46% increase in feeling rested upon waking in the morning (p<.001). Additionally, at the beginning of the study, 60% of participants reported having racing thoughts or worrying when trying to fall asleep. While using the sound machine, only 30% of participants experienced this concern.
Conclusion: Participants perceived a variety of benefits from sound machine use, even though these improvements were not observed in their objective sleep data. Given that adjustment to any product used during sleep varies from person to person, it is possible that changes in the objective sleep data might have been observed if the product use period had been longer. This study adds to the ongoing discussion of using noise as a sleep aid.
Support (if any): ASTI

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BLUE LIGHT FILTERING LAPTOP AND TABLET SCREEN PROTECTORS USED AFTER SUNSET IMPROVE SLEEP

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Introduction: Light exposure at night is associated with altered sleep behavior and impaired sleep satisfaction, in part due to suppressing the release of melatonin. According to a National Sleep Foundation poll, 90% of people report using electronic devices within an hour of bed at least a few times per week. This study aimed to examine how use of EyeJust, a blue light filtering screen protector applied to laptops and tablet devices, impacted sleep.
Methods: A within subjects, pre-post intervention design was implemented. Adults (n=24) who self-reported regular blue light exposure after sunset and eye strain participated in a 6-week study (3 weeks of baseline followed by 3 weeks of product use). Intervention consisted of the use of blue light filtering screen protectors on iOS devices used after sunset. Sleep was measured objectively each night using SleepScore Max and by self-report. Participants also reported level of eye strain each night. Multilevel regression and paired t-tests were used to test for statistical significance.
Results: Across participants (75% female; age 21-50, avg. 37), there were 850 nights of sleep measured. When measured pre-post, many aspects of perceived sleep improved when using the screen protectors: sleepiness at bedtime, falling asleep in the preferred amount of time, ability to sleep through the night, feeling rested in the morning, sleep quality, and satisfaction with sleep (ps<.05). When measured daily, improvement was seen in eye strain, perceived time to fall asleep, perceived awakenings, and time spent awake at night (ps<.05). Objective sleep improvement was found in a subgroup of younger adults (age 21-35). They spent more time in bed (p=.03) and slept longer (6 hours, 40 minutes on average during baseline vs. 6 hours, 50 minutes during intervention; p=.04). This subgroup also had more REM sleep as reflected by a 2% increase in MindScore (measure of REM sleep; p=.04)
Conclusion: Using blue light filtering screen protectors helped improve sleep, measured by self-report and objectively, especially among younger adults. This intervention may help reduce the negative impact electronic devices have on sleep.
Support (if any): EyeJust

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CONTACT-FREE SNORING SOLUTION REDUCES OBJECTIVELY-MEASURED SNORING AND IMPROVES BED PARTNERS' OBJECTIVELY-MEASURED SLEEP

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Introduction: Snoring can disturb the sleep of snorers as well as their bed partners. Recent technological advances allow objective measurement of sleep and snoring in the comfort of the bedroom. This study examined effects of a non-medical contactless snoring solution on snoring and sleep in snorers and their partners.
Methods: Self-reported snorers (n=29; 72% male; age 25-59 years, avg. 43; BMI<30) with non-snoring bed partners tracked their snoring nightly with the Do I Snore or Grind app while using the snoring solution at home (527 total nights across participants). During this time, partners tracked their own sleep nightly using ResMed S+. In addition, self-report data were collected from both snorers and partners. A within-subjects, pre-post design was used, comparing a 2-week

baseline period to 2 weeks of nightly product use. Multilevel regression and paired t-tests were used to test for statistical significance. The snoring solution (Smart Nora) included a pillow insert that gently inflates when early sounds of snoring are detected, enabling breathing to return to normal.

Results: Objectively-measured average snoring reduced from 10% of the night when not using the product to 9% during the first week of use and 7% during the second week of use ($p<.05$). Partners perceived the snoring as less loud and less severe when the product was used. At the end of the study, no partner described the snoring as severe. Objectively-measured sleep of partners revealed a 16% decrease in wake after sleep onset ($p<.05$). Prior to product use, they spent an average of 38 minutes awake after falling asleep (approximately 9% of their sleep period). This decreased to 34 minutes during the first week of product use and to 32 minutes during the second week. Product use also led to improvements in the perceived sleep of snorers and their partners, including ability to sleep through the night without waking up, overall sleep quality, and feeling rested upon waking in the morning (all $ps<.05$).

Conclusion: By reducing the amount of snoring, the contactless snoring solution improved objectively-measured sleep in snorers' bed partners. Also, the perceived sleep of both snorers and their partners improved.

Support (if any): Smart Nora

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PERIOPERATIVE SLEEP STUDY IN GERIATRIC CARDIAC SURGICAL PATIENTS USING WIRELESS WEARABLE DEVICES

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Introduction: Sleep is a fundamental necessity for health and is commonly disrupted in the perioperative period. Technological improvements leveraging dry electroencephalographic (EEG) sensors have opened the door for large-scale quantitative assessments of sleep in relation to perioperative outcomes.

Methods: Patients utilized the Dreem (Rhythm, New York USA), a wireless EEG headband, to acquire their own preoperative nocturnal sleep records at home. Following cardiac surgery, postoperative recordings were obtained with staff assistance until postoperative night 7. Sleep records were scored as rapid eye movement (REM) and non-rapid eye movement (NREM) stages N1-N3, using modified American Academy of Sleep Medicine guidelines.

Results: Of 100 patients enrolled for perioperative sleep recordings, 74 patients provided 132 preoperative records; 80% were scorable with a median total sleep time (TST) of 209.8 minutes. TST was distributed as 8.3% N1, 70.6% N2, 2.1% N3 and 19% REM, consistent with expected sleep structure in geriatric populations. EEG markers for staging sleep were evaluated in the scorable records: 92% with sleep spindles, 98% with K-complexes, 69% with slow waves, 92% with sawtooth waves, and 80% with rapid eye movements. Among 26 patients with multiple preoperative sleep recordings, no significant within-subject differences in sleep structure were observed (all $p > 0.05$, paired Wilcoxon sign-rank test). 270 postoperative nocturnal sleep recordings were obtained from 83 patients, 70% of which were scorable. TST in scorable postoperative records was distributed as 14.9% N1, 78.6% N2, 0.9% N3 and 5.6% REM. Durations of REM and N3 sleep were significantly reduced in postoperative (POD 1-4) overnight recordings compared to preoperative measurements (Skillings–Mack test, $p < 0.001$ and $p = 0.02$ for REM and N3, respectively).

Conclusion: Wireless EEG devices enhance the feasibility of assaying perioperative sleep. A single night of unattended, ambulatory sleep monitoring is sufficient to establish a preoperative baseline. Multiple preoperative and postoperative sleep studies were tolerated by patients, which showed reductions of N3 and REM sleep in the early postoperative period. This study demonstrates the feasibility of using the Dreem for monitoring sleep macro- and microstructural EEG elements in the perioperative setting.

Support (if any):

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SMART POLYMER IMPLANTS AS AN EMERGING TECHNOLOGY FOR TREATING AIRWAY COLLAPSE IN OSA: A PROOF OF CONCEPT STUDY

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Introduction: Implantable 3D printed 'smart' polymers are an emerging technology with potential applications in treating collapse in adult obstructive sleep apnea through mechanical airway manipulation. There is a paucity of devices that are commercially available or in research and development stage. Limited studies have investigated the use of implantable smart polymers in reversing the collapsibility of the pharyngeal airway by creating counter forces during sleep. This paper describes an application of implantable magnetic polymer technology in an in-vivo porcine model. Study Objectives: To assess the use of a novel magnetic polymer implant in reversing airway collapse and identifying potential anatomical targets for airway implant surgery in an in-vivo porcine model.

Methods: Target sites of airway collapse were genioglossus muscle, hyoid bone and middle constrictor. Magnetic polymer implants were sutured to these sites and external magnetic forces, through magnets with pull forces rated at 102kg and 294kg, were applied at the skin. The resultant airway movement was assessed via nasendoscopy. Pharyngeal plexus branches to the middle constrictor muscle were stimulated at 0.5mA, 1.0mA and 2.0mA and airway movement assessed via nasendoscopy.

Results: At the genioglossus muscles large magnetic forces were required to produce airway movement. At the hyoid bone, anterior movement of the airway was noted when using a 294kg rated magnet. At the middle constrictor muscle, an anterolateral (or rotatory) pattern of airway movement was noted when using the same magnet. Stimulation of pharyngeal plexus branches to the middle constrictor revealed contraction and increasing rigidity of the lateral walls of the airway as stimulation amplitude increased. The resultant effect was prevention of collapse, a previously unidentified pattern of airway movement.

Conclusion: Surgically implanted smart polymers are an emerging technology showing promise in the treatment of airway collapse in obstructive sleep apnea. Future research should investigate their

biomechanical role as an adjunct to treatment of airway collapse through nerve stimulation.
Support (if any): Garnett-Passe and Rodney Williams Memorial Foundation, Conjoint Grant, 2016-18.

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SLEEP ENHANCEMENT TECHNOLOGY: A SURVEY OF APPS

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Introduction: The ever-evolving market for sleep technologies far outpaces the ability of providers to understand and counsel patients about developments in this area. Although significant literature has validated the performance of sleep tracking technologies, there is little evidence regarding sleep enhancement technologies. Our study systematically surveys currently available commercial sleep enhancement smartphone applications to empower both providers and patients alike.
Methods: We systematically searched the App Store (Apple) and Google Play Store (Android) in the US on 26 MAY 2020 using the keyword "sleep." This survey is inclusive of all smartphone applications found.
Results: We identified 342 apps: 70.2% were found on Android (N=240) and 29.8% on Apple (N=102). Ninety-five percent of apps offer a free version. The majority of sleep apps are intended for use during wake (65.8% exclusively during wake; 28.7% during both wake and sleep), with only 5.6% intended to be used during sleep alone. Most apps purport to enhance rather than measure sleep (78.7% versus 1.8%). The vast majority of apps claim to enhance sleep via reductions in sleep latency (65.8%). Reduced sleep latency is primarily achieved using a combination of non-verbal auditory stimuli such as nature sounds (84.4%), artificial stimuli (64.5%), and instrumental music (77.1%).
Conclusion: Interestingly, most sleep apps are designed to be used while awake, prior to sleep, and focus on the enhancement of sleep, rather than measurement, by targeting sleep latency. Given the multitude of available sleep enhancement apps, many of which are free to try, these should be considered a reasonable strategy for providers and consumers to consider for empowering patients to improve sleep!
Support (if any): Department of Defense Military Operational Medicine Research Program (MOMRP)

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SLEEP ENHANCEMENT TECHNOLOGY: A SURVEY OF DEVICES

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Introduction: Innovations in consumer sleep technologies have risen exponentially and providers struggle to keep up with patient expectations in this arena. Although there is high quality data on the validity on commercial sleep monitoring devices, there has been a rise in devices for the explicit purpose of sleep enhancement. We sought to identify existing consumer sleep devices that claim to enhance sleep, provide a comprehensive review of the main characteristics of these devices, and look into the types of evidence the developers offered to support their claims.
Methods: Using a scoping review framework we identified and mapped out the main characteristics of sleep enhancement devices in the consumer market. We systematically used a common search engine and the FDA database using various combinations of sleep-related search terms, such as "sleep enhancement device". Through an iterative process, we identified and categorized devices based on the intervention target. Devices that were exclusively for clinical use and required a prescription, such as for the treatment of obstructive sleep apnea or diagnosed insomnia, were excluded.
Results: We identified 34 sleep enhancement devices, all 34 were found via web search and one was also found in the FDA Database. We defined the following overlapping categories: reduce sleep latency (94.1%), increase restorative sleep (17.6%), and/or "other" (32.4%). About half of the devices use sound (44.1%), 26.5% use visual stimuli, and 11.8% use vibration. Additionally, roughly a third of all devices claim to entrain brain signals associated with sleep. Half of devices found operate near the bed without being in contact with the consumer, 44.1% are worn on the body, and the remaining 5.9% operate in bed, near the consumer.
Conclusion: For the most part, commercial sleep enhancement devices target sleep latency or claim to increase the restorative power of sleep. These devices generally use auditory, visual, and vibratory stimuli, and half are worn on the body. Lack of evidence supporting whether these devices actually improve sleep questions the utility of such devices and demonstrates the need for validation standards for consumer sleep enhancement devices.
Support (if any): Department of Defense Military Operational Medicine Research Program (MOMRP)

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SLEEP STAGING PERFORMANCE OF A SIGNAL-AGNOSTIC CLOUD-BASED REAL-TIME SLEEP ANALYTICS PLATFORM

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Introduction: The coronavirus pandemic has brought unprecedented changes to the health care system, including sleep medicine. Remote monitoring and telemedicine played a significant role in this shift. We anticipate these changes to continue in the future with internet-connected wearables (ICWs) playing an important role in measuring and managing sleep remotely. As these ICWs measures a small subset of signals traditionally measured during polysomnography (PSG), manual sleep staging becomes non-trivial and sometimes impossible. The ability to do accurate and reliable automatic sleep staging using different modalities of physiological signals remotely is becoming ever more important.
Methods: The current work seeks to quantify the sleep staging performance of Z3Score-Neo (https://z3score.com, Neurobit Technologies, Singapore), a signal agnostic, cloud-based real-time sleep analytics platform. We tested its staging performance on the CINC open dataset with N=994 subjects using various combinations of signals including Electroencephalogram (EEG), Electrooculogram (EOG), Electromyogram (EMG), and Instantaneous Heart Rate (IHR) derived from Electrocardiogram (ECG). The staging was compared against manual scoring based on PSG. For IHR based staging, N1 and N2 were combined.
Results: We achieved substantial agreement (all Cohen's Kappa > 0.7) between automatic and manual staging using various combinations of EEG, EOG and EMG channels with accuracies varying between 81.76% (two central EEGs, one EOG, one EMG), 79.31% (EEG+EOG), 78.73% (EEG only) and 78.09% (one EOG). We achieved moderate agreement (accuracy: 72.8% κ=0.54) with IHR derived from ECG.

Conclusion: Our results demonstrated the accuracy of a cloud-based sleep analytics platform on an open dataset, using various combinations of ecologically valid physiological signals. EOG and EMG channels can be easily self-administered using sticker-based electrodes and can be added to existing home sleep apnea test (HSAT) kits significantly improving their utility. ICWs are already capable of accurately measuring EEG/EOG (Muse, InteraXon Inc., Toronto, Canada; Dreem band, Dreem, USA) and IHR derived from ECG (Movesense, Suunto, Finland) or photoplethysmogram (Oura Ring, Oura Health Oy, Finland) or through non-contact ballistocardiogram/radio-based measurements (Dozee, Turtle Shell Technologies, India; Sleepiz, Sleepiz AG, Switzerland). Therefore, a well-validated cloud-based staging platform solves a major technological hurdle towards the proliferation of remote monitoring and telehealth in sleep medicine.
Support (if any):

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LONG-TERM MONITORING OF TRAIT-LIKE CHARACTERISTICS OF THE SLEEP ELECTROENCEPHALOGRAM USING EAR-EEG

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Introduction: Wearable electroencephalogram (EEG) monitoring has a remarkable potential, it is safe, scalable and can track neural signatures for long periods. One such signature is the power spectra of non-rapid-eye-movement (NREM) sleep which has been shown to demonstrate a trait-like characteristic. Changes in personalized signatures has been associated with biomarkers of Alzheimer's disease and is of great interest for early detection and clinical management. This work investigates monitoring of signatures using a wearable device that records EEG from the ear (ear-EEG) and compares the intra- and inter-individual similarity of the neural signatures with that from central scalp-EEG.
Methods: We initiated a two phased in-home study, monitoring 20 subjects for 4 nights (A), followed by a delayed but continued monitoring of 10 subjects for 12 nights (B). In A, subjects wore a dry-electrode ear-EEG system and a partial PSG, in B the subjects wore only the ear-EEG system. Subjects were instructed to follow their usual time schedule and lifestyle. Sleep stages were scored manually according to AASM in A and automatically in B. The grand average power spectra of NREM2 sleep were computed and log-transformed prior to calculating the cosine similarity for determination of the intra- and inter-individual similarity.
Results: The ear-EEG and scalp-EEG analysis showed that mean intra-individual similarity was higher than mean inter-individual similarity. Permutation tests indicate that the observed mean difference is statistically significant $p<0.01$ for both montages. Comparing the distributions of intra-individual similarities for ear-EEG and scalp-EEG, the observed mean difference is statistically significant $p<0.05$, in favor of a more stable ear-EEG signature. Comparing ear-EEG signatures between A and B, considering nights from A as reference, all subjects from B were most similar with its own reference signature. Considering signatures from individual nights the accuracy paring subjects from A and B were 88% correct.
Conclusion: Nocturnal ear-EEG measures trait-like characteristics as reliable as scalp-EEG. The neural signature is stable over time within healthy subjects and demonstrated its ability as a personalized signature.
Support (if any):

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AUTOMATIC SLEEP STAGING WITH PHOTOPLETHYSMOGRAPHY AND ACCELEROMETER IN A COMMUNITY-BASED POPULATION

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Introduction: The study aims to validate the automatic sleep staging system (ASSS) with photoplethysmography (PPG) and accelerometers embedded in smart watches in community-based population
Methods: 75 healthy subjects were randomly recruited form 304 staffs in an industrial firm who volunteered for this study. A four-stage classifier was designed based on Linear Discriminant Analysis using PPG and accelerometers. To better validate the system performance, the leave-one-out approach was applied in this study. The performance of ASSS was assessed with the epoch-by-epoch and whole-night agreement for sleep staging against manual scoring of overnight polysomnography.
Results: The mean agreement of four stages across all subjects was 61.1% (95% CI, 58.9-63.2) with kappa 0.55 (0.52-0.58). The mean agreement for wake, light sleep (LS), deep sleep (DS), and REM was 53.4%, 84.1%, 40.3%, 75.6%, respectively. The whole-night agreement was good-excellent (Intra-class correlation coefficient, 0.74 to 0.84) for total sleep time, sleep efficiency, wake after sleep onset, and duration of wake and REM. The agreement was fair for sleep onset and LS duration, but poor for DS duration.
Conclusion: Our result showed that PPG and accelerometers based smart watches have proper validity for automatic sleep staging in the community-based population.
Support (if any): "Center for electronics technology integration (NTU-107L900502, 108L900502, 109-2314-B-002-252)" from the Featured Areas Research Center Program within the framework of the Higher Education Sprout Project by the Ministry of Education (MOE) in Taiwan; MediaTek Inc (201802034 RIPD).

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MULTIMODAL LONGITUDINAL SLEEP TRACKING COMBINING WEARABLE, SMARTPHONE TAP ANALYSIS AND ELECTRONIC QUESTIONNAIRES

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Introduction: The proliferation of wearable and smartphone technologies has enabled continuous monitoring of sleep using data from different channels (physiological [wearables], behavioural [phone usage] and ecological momentary assessment [EMA self-report]). As these modalities use different methods to assess sleep, information gaps suggested by discrepancies between estimates may be filled in through cross-referencing among the modalities to produce a more accurate sleep measurement. Moreover, the pattern of discrepancies could inform about specific sleep and peri-sleep behaviors (e.g. phone use before bedtime).
Methods: 198 staff and students from the National University of Singapore (61 male, mean age 26.15±5.83 years) were recruited for an 8-week study. Sleep timings were assessed daily from three modalities: a wearable sleep and activity tracker (Oura ring), estimations from smartphone touchscreen interactions (tappigraphy) and smartphone

derived EMA self-reports. Sleep estimates from the different modalities were compared for agreement (bivariate correlation) and discrepancies (t-test). Additionally, clustering analysis of high-discrepancy nights (>1h discrepancy between modalities) was performed to identify pattens of sleep behaviors that could lead to specific discrepancies.
Results: Adherence throughout the 8-week monitoring period (total 11,088 nights) was = high for the Oura ring; 9826 nights [80%]), Tappigraphy; 9740 nights [88%)), and EMA; 9166 nights [83%]). Sleep estimates across the three modalities showed high agreement (r=0.79-.91), with some discrepancies: Relative to self-report data, Oura wake time tended to be a later (Mean diff=9mins, t=18.58, p<.001), while tappigraphy estimates of bedtime tended to be early (Mean diff=15mins, t=26.48, p<.001). On 23% of nights (1755 nights), however, large discrepancies were detected (>1h). K-means clustering identified three distinct patterns of discrepancy, which were dominantly expressed in different individuals. Group comparison revealed that these individuals differed in demographic variables (age, student/work status), sleep variables (sleep timing, duration, subjective sleepiness), and phone usage characteristics (overall and pre-bedtime phone usage).
Conclusion: These data show that the combined use of three streams of data concerning sleep is complementary. Moreover, discrepancy patterns provide specific insights into sleep and peri-sleep behaviors facilitating digital phenotyping.
Support (if any): This research was supported by the National Medical Research Council Singapore (NMRC/STaR/015/2013 and NMRC/STaR19may-0001).

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EVALUATION OF MULTIPLE WEARABLE SLEEP-TRACKING DEVICES TESTED UNDER AD LIB HOME SLEEP CONDITIONS

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Introduction: Consumer wearable sleep-tracking devices are increasingly popular and have performed well versus gold standard sleep measurement techniques (polysomnography and actigraphy) in recent validation studies. However, most validation studies were conducted in laboratories under controlled conditions. We therefore aimed to test the validation performance of multiple consumer wearable sleep-tracking devices under real-world ad lib sleep conditions at home.
Methods: We tested 21 healthy young adults (12 women, 9 men; 29.0±5.0 years, mean±SD) for 7 nights each. Participants slept at home under ad lib sleep conditions, using a set of consumer wearable sleep-tracking devices and completed daily sleep diaries. Consumer wearables included the Fatigue Science Readiband, Fitbit Inspire HR, Oura Ring, and Polar Vantage V Titan. Participants also wore the Philips Respironics Actiwatch 2, a research-grade actigraphy watch, for comparison. To assess validity of sleep/wake measures, all devices were compared with the previously-validated Dreem 2 electroencephalography-based headband device. Analyses included agreement of epoch-by-epoch sensitivity (for sleep) and specificity (for wake), and sleep summary comparisons of time-in-bed (TIB) and total sleep time (TST).
Results: Sensitivity and specificity, respectively, were as follows: Actiwatch 2 (0.95, 0.36), Readiband (0.93, 0.43), Inspire HR (0.93, 0.45), Ring (0.94, 0.41), and Vantage V Titan (0.96, 0.33). Device average biases, in minutes±SD, for TIB and TST, respectively, were as follows: Actiwatch 2 (N/A, +0.7±42.4), Readiband (+18.2±34.9, +0.4±49.5), Inspire HR (+7.8±35.0, -5.9±44.4), Ring (+9.2±28.0, +4.4±44.5), and Vantage V Titan (+0.2±50.0, -3.2±46.1).
Conclusion: The consumer wearable devices had comparable sleep-tracking performance during real-world ad lib home sleep. Similar to prior studies, the devices all had high sensitivity and low-to-medium specificity, indicating a greater ability to accurately detect sleep than wake. Notably, specificity for most consumer wearables was higher than a research-grade actigraph, indicating potentially greater ability than actigraphy to detect wake. Sleep summary outcomes were similar among the wearables, which accurately tracked TIB and TST on most nights. However, on some nights there was still considerable bias and variability. Overall, preliminary findings indicate that consumer wearables are promising for tracking sleep and wake in real-world home conditions.
Support (if any): Office of Naval Research, Code 34

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THE ACTIGPATCH: VALIDATION OF A NOVEL ADHESIVE MONITOR AGAINST PSG AND WRIST-ACTIGRAPHY.

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Introduction: Wrist actigraphy is a gold-standard method for estimating sleep patterns in the field. Actigraphy adherence is limited when participants remove the device for daily activities (e.g., showers, exercise). Here we evaluate the validity of a novel water-resistant wearable, the "Actigpatch," compared to polysomnography and traditional actigraphy.
Methods: Seven adults (4F; aged 22-54 years [m: 31.1±13.1]) slept in the laboratory for a total of 33 nights. Participants wore a Micro Motionlogger actigraphy (Ambulatory Monitoring Inc., Ardley, NY) on the non-dominant wrist and the Actigpatch—a 0.5in2 circuit board enclosed in a water-resistant adhesive (Circadian Positioning Systems, Newport, RI)—on the triceps. Both devices recorded tri-axial accelerometry, with sleep-wake estimates produced in 1-minute epochs (Sadeh algorithm). Simultaneous PSG data were reduced to 1-minute resolution favoring wake, keeping with recent recommendations. We computed epoch-by-epoch confusion matrices and derived 2 validation parameters: sensitivity (e.g., ability to detect sleep) and specificity (e.g., ability to detect wake). Finally, we compared total sleep time estimates (TST) to evaluate the bias of each device. Nested mixed models (nights within individuals) compared device performance.
Results: The Actigpatch demonstrated high sensitivity (.95; 95%CI: [.92 .98]) and specificity (.89; [.86, .91]) against polysomnography. Similar sensitivity (.96; [.94, .99]) and specificity (.84; [.78 .91]) were found comparing the Actigpatch to the Motionlogger. Comparing the devices' validity with PSG, sensitivity was not statistically different between the Actigpatch and Motionlogger (b=.0041, t=0.56; p=.58); however, the Motionlogger demonstrated higher specificity (.95; [.92, .97]) compared to the Actigpatch (b=0.065, t=4.69; p<.001). To that end, TST estimates were longer (p=.016) for the Actigpatch (449min; [428, 471] relative to the Motionlogger (438min; [416, 459]).
Conclusion: These data indicate that the adhesive "Actigpatch" is as sensitive to detect polysomnographic-confirmed sleep as a common research-grade actigraph. The Actigpatch may be less capable of detecting wake episodes. Unlike traditional actigraphs, the Actigpatch can be worn continuously for 3 weeks without risk of water or impact damage. Participants are not responsible for remembering to wear the device. Field studies, or studies in populations struggling with adherence (e.g., children) may benefit from wearable monitors such as the Actigpatch.
Support (if any): R01AA025593, Circadian Positioning Systems

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TUNABLE WHITE LIGHT FOR ELDERS (TWLITE): A FEASIBILITY STUDY OF A HOME-BASED SLEEP INTERVENTION

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Introduction: Sleep disturbances are common in elderly patients and may contribute to disease progression in certain populations (e.g., Alzheimer's Disease). Light therapy is a simple and cost-effective intervention to improve sleep. Primary barriers to light therapy are 1) poor acceptability to use of devices and 2) inflexibility of current devices to deliver beyond a fixed spectrum and throughout the entirety of the day. However, dynamic, tunable lighting integrated into the native home lighting system can maximize short-wavelength light in the morning and minimize short-wavelength light in the evening, thus entraining circadian rhythms and treating sleep disturbances, and overcome these limitations. We determined the feasibility of implementing a whole-home tunable lighting system as a potential sleep intervention.

Methods: Tunable LED lights were installed throughout the homes of healthy older adults already enrolled in an existing study with embedded home assessment platforms (ORCATECH study; n=4 subjects in n=3 homes). In ORCATECH, continuous data on room location, activity, sleep, and general health parameters are collected at minute-to-minute resolution over months to years of participation. This single arm longitudinal design collected participants' light usage in addition to ORCATECH outcome measures. Primary outcomes for this pilot study included the feasibility and patient acceptability. Exploratory outcomes were sleep metrics (sleep time, latency, efficiency), mobility (room transitions and actigraphy), and overall health indices (weekly body weight, self-report general health questionnaires) both pre- and post-intervention.

Results: Two subjects terminated the study citing technical difficulties with the lights and a preference for brighter illumination. Of the remaining 2 participants, sleep metrics were explored over a 12-month period spanning pre- and post-installation of lights. Nightly duration in bed was compared with minute-to-minute room entry data and actigraphy with high inter-measure reliability.

Conclusion: These data support that tunable whole-home lighting systems are reasonably acceptable and feasibly implemented using an automated platform for continuous data collection. Quantification of sleep over long periods of time is robust and reliable in the home environment of elderly subjects. These results will inform implementation of future large-scale lighting intervention studies in patients at risk for developing Alzheimer's Disease.

Support (if any): Hartford Gerontological Center Interprofessional Award, Pacific Northwest National Laboratory, OHSU ORCATECH

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UNDERSTANDING PERSPECTIVES ON ARTIFICIAL INTELLIGENCE TECHNOLOGIES FOR SLEEP SELF-MANAGEMENT

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Introduction: Until recently, understanding one's sleep activity relied on technology only available in sleep labs with data analyzed by experts. Transitioning this technology from the lab to natural environments results in noisy data. Fortunately, advances in signal processing through Artificial Intelligence (AI) have made these technologies accessible to consumers. This study seeks to provide recommendations that address user preferences and concerns related to sleep self-management devices and software that leverage AI, as they have the potential to increase both the quantity and quality of sleep data available to researchers.

Methods: We assigned adult participants (N=25) with Pittsburgh Sleep Quality Index scores ≥ 5 (indicating low sleep quality) to one of four focus group sessions based on their self-reported prior use of sleep technologies. After a short demonstration, the moderator solicited participant feedback on devices and software in each of the following four categories: • headbands (Beddr, Dreem 2, Muse S) • sleep tracking mats (Withings) • snoring detectors (Smart Nora) • mobile applications (Sleep Cycle Alarm Clock, Sleep Score, Do I Snore, Sleep Rate)

Results: Participants anticipated discomfort from wearing headbands and placing snoring detectors under their pillow, although a subset of participants indicated that they would be willing to sacrifice comfort in exchange for improved accuracy. Conversely, participants were interested in sleep tracking pads since they could passively collect sleep data without additional burden. Similarly, participants viewed mobile applications positively due to their ability to collect sleep data from a nightstand rather than being attached to the participant; however, there were concerns about remembering to activate these applications.

Conclusion: Based on these results, we recommend using sleep tracking mats to collect patient-generated sleep data due to their ease of use and relative comfort, the main concerns related to lab-based sleep study participation. As a passive sensor, these require the least setup and support consistent data collection. Other devices run the risk of participants forgetting to use the device or becoming removed during the night resulting in missing data. By leveraging these existing technologies for remote sleep studies, researchers can increase recruitment and accessibility to promote sleep research participant diversity.

Support (if any):

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WACSAW: A STATISTICAL AND INDIVIDUALLY ADAPTIVE METHOD TO DETERMINE SLEEP AND WAKEFULNESS FROM ACTIVITY.

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Introduction: Technological innovations have broadened the type and amount of activity data that can be captured in the home and under normal living conditions. Yet, converting naturalistic activity patterns into sleep and wakefulness states has remained a challenge. Despite the successes of current algorithms, they do not fill all actigraphy needs. We have developed a novel statistical approach to determine sleep and wakefulness times, called the Wasserstein Algorithm for Classifying Sleep and Wakefulness (WACSAW), and validated the algorithm in a small cohort of healthy participants.

Methods: WACSAW functional routines: 1) Conversion of the tri-axial movement data into a univariate time series; 2) Construction of a Wasserstein weighted sum (WSS) time series by measuring the Wasserstein distance between equidistant distributions of movement data before and after the time-point of interest; 3) Segmenting the time series by identifying changepoints based on the behavior of the WSS series; 4) Merging segments deemed similar by the Levene test; 5) Comparing segments by optimal transport methodology to determine the difference from a flat, invariant distribution at zero. The

resulting histogram can be used to determine sleep and wakefulness parameters around a threshold determined for each individual based on histogram properties. To validate the algorithm, participants wore the GENEActiv and a commercial grade actigraphy watch for 48 hours. The accuracy of WACSAW was compared to a detailed activity log and benchmarked against the results of the output from commercial wrist actigraph.

Results: WACSAW performed with an average accuracy, sensitivity, and specificity of >95% compared to detailed activity logs in 10 healthy-sleeping individuals of mixed sexes and ages. We then compared WACSAW's performance against a common wrist-worn, commercial sleep monitor. WACSAW outperformed the commercial grade system in each participant compared to activity logs and the variability between subjects was cut substantially.

Conclusion: The performance of WACSAW demonstrates good results in a small test cohort. In addition, WACSAW is 1) open-source, 2) individually adaptive, 3) indicates individual reliability, 4) based on the activity data stream, and 5) requires little human intervention. WACSAW is worthy of validating against polysomnography and in patients with sleep disorders to determine its overall effectiveness.

Support (if any):

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IS BLUE-ENRICHED LIGHT MORE EFFECTIVE THAN RED LIGHT TO ENHANCE VIGILANCE AND COGNITIVE PERFORMANCE IN PARKINSON'S DISEASE?

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Introduction: Approximately 50% (between 16–74%) of adults with Parkinson's disease (PD) show excessive daytime sleepiness. Besides its important role for vision, light conveys a powerful stimulating signal for alertness and cognition. Recent research has demonstrated that the blue part of light spectrum is the most efficient in enhancing vigilance and cognitive performance in young and older healthy individuals, thanks to a specific photoreception system within the eye which is particularly sensitive to blue wavelength. The aim of this pilot study was to compare the effects of blue-enriched light exposure (BL) and red-light placebo exposure (RL) on psychomotor vigilance and cognitive performance in adults with PD.

Methods: Sixteen participants with idiopathic PD (64.0±5.5 yrs, 6 women, Hoehn and Yahr status: 2) completed a brief neuropsychological assessment to exclude dementia, self-reported questionnaires and a complete eye examination in screening visits. The one-day experimental procedure included 1.25 h period of baseline dim-light exposition, followed by two light conditions presented in a counterbalanced design and separated by 15 minutes in dim-light: 1.25 h of BL at 959lux and 1.25 h of placebo RL condition at 472lux. Both light conditions were delivered by Luminette®. Data were normalized according to baseline dim-light evaluation. Mixed analyses of variance (2 light conditions X 2 orders) were performed to compare performance on an auditory psychomotor vigilance task (A-PVT) and an auditory 2-back cognitive tasks (A-2-back) during light exposure.

Results: We observed no significant effect of light conditions, orders and no interaction on reaction time (RT) and number of correct answers for the A-2-Back task. Furthermore, there was no significant difference between BL and RL on A-PVT performance including median RT, shift in optimum RT (i.e.,mean RT from fastest 10% RT), and duration of response in the lapse domain (i.e.,mean RT from slowest 10% RT).

Conclusion: These preliminary results do not support the notion that blue-enriched white light exposure is more efficient than red light exposure to stimulate psychomotor vigilance and cognitive performance in adults with PD. Next steps of analyses will compare the effects of BL and RL on subjective sleepiness and EEG cortical activation in the same population.

Support (if any): CIHC & QPN

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FEASIBILITY, ACCEPTABILITY, AND PRELIMINARY IMPACT OF A SCHOOL-BASED SLEEP PROMOTION PROGRAM FOR ADOLESCENTS

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Introduction: Poor sleep is common among adolescents and has been linked with school absenteeism. Though improved sleep has been associated with improved school outcomes, intervention programs for insufficient sleep are not standard in schools, few have used an individualized approach, and none have focused on youth with absenteeism. We conducted an open trial of the feasibility, acceptability, and initial impact of our school-based sleep promotion program among adolescents.
Methods: Participants included 8th and 9th grade students with mild absenteeism, insufficient sleep, and sleep timing shift on the School Sleep Habits Survey (SSHS). The program included a smartphone-based sleep diary and 1-2 tailored sessions with a school staff member. Participants completed baseline and follow-up research assessments. The sleep program focused on education about sleep; cognitive strategies targeting sleep beliefs; stimulus control; and regularization of sleep and wake. We descriptively report program feasibility, acceptability, and change in sleep duration.
Results: Of 33 participants approached by school staff, 12 agreed to participate and 10 completed the study. Seven participants had two program sessions and 5 participants had one program session. Sleep duration increased by 19 minutes across the entire week based on daily sleep diary, and by 31 minutes on weekdays on the SSHS. Most participants (89%) reported that the program was not a burden on their time, that the program length was just right (88%), and that they were likely to participate in research again (75%). While program feasibility was high, most youth (56%) rated program relevance as low or unknown. The most salient implementation barrier was the challenge of embedding the program into each school's existing procedures.
Conclusion: A school-based sleep promotion program for adolescents with insufficient sleep and mild absenteeism is feasible, acceptable, and associated with improved sleep. An individualized approach, with sessions delivered by school staff, shows great promise for being feasible and clinically significant. Future work should focus on selecting a sample of youth with greater investment in the program to improve school attendance and implementing the program flexibly and with fidelity across schools.
Support (if any): University of Pittsburgh Center for Interventions for Improve Community Health

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EFFECT OF CIRCADIAN MISALIGNMENT ON THE SLEEP OF POLICE OFFICERS ACROSS A SERIES OF NIGHT SHIFTS

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Introduction: Misalignment of behavior and circadian rhythms due to night work can impair sleep and waking function. While both simulated and field-based studies suggest that circadian adaptation to a nocturnal schedule is slow, the rates of adaptation in real-world shift-work conditions are still largely unknown. The aim of this study was to evaluate the extent of adaptation of 24-h rhythms in 6-sulfatoxymelatonin (aMT6s) and cortisol in police officers across night shifts and to compare their effect on sleep.
Methods: A total of 76 police officers (20 women; aged 32.3±5.5 years, mean±SD) from the province of Québec, Canada, participated in a field study comprising their 28- or 35-day work-cycle. Urine samples were collected for ~24-h before and after a series of 3–7 night shifts. Rhythms of urinary aMT6s were considered adapted if midpoints following night shifts occurred during participants' average daytime sleep period. Cortisol was considered adapted if midpoints occurred within 2h of their average daytime sleep offset. Sleep was measured with actigraphy and sleep logs on a cell phone. Data were analyzed with circular and linear mixed-effects models.
Results: Analyses were based on a subset of 37 participants with rhythms of both hormones suitable for circadian phase assessment before and after their series of night shifts. After night shifts, the group acrophase of adapted rhythms (aMT6: n=11, cortisol: n=9) occurred significantly later than for non-adapted rhythms (aMT6s: 10.9 h vs. 3.4 h, $p<.001$; cortisol: 14.9 vs. 9.9 h, $p<.001$). Participants with adapted aMT6s rhythms obtained cumulatively more sleep per day throughout the series of shifts than those with non-adapted rhythms (average 6.4 h per day vs 5.8 h per day; $p=.026$).
Conclusion: Consistent with prior research, our results from both urinary aMT6s and cortisol midpoints indicate that a large proportion of police officers remained in a state of circadian misalignment following their night shifts. The minority of officers who adapted to night work were able to obtain more sleep across consecutive night shifts.
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TRAVEL FACTORS IN AWAY GAMES: A CASE STUDY OF A WOMEN'S COLLEGE BASKETBALL TEAM

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Introduction: Previous investigations in professional basketball, football, and other sports have shown meaningful effects of factors like rest and length of a team's road trip on overall performance, with detriments being attributed to travel. However, prior research in the context of college basketball has been relatively scant. Thus, the current study extends the literature by performing a case study on the impact of such travel factors on a women's college basketball team.
Methods: Data from a total of 110 road games played over the last 10 seasons from 2010 to 2020 by a National Association of Intercollegiate Athletics (NAIA) women's college basketball team were collected from the college's athletics site. We examined the influence of consecutive games played away, days in between games, back-to-back games, and miles traveled by the team on game outcomes and team performance. Specifically, we inspected box-score statistics, such as points scored, points allowed, shooting percentages (i.e., field-goal, free-throw, and three-point), rebounds, blocks, steals, assists, personal fouls, and turnovers. We performed a series of generalized regressions controlling for the team and opponent winning percentages entering each game, along with the opponent's home time zone. Although neutral site games were excluded from our analyses, such events were still considered in determining the number of consecutive games played away from home.

Results: Our analyses revealed that the team scored significantly more points (p = .03), and won more games (p = .04) when traveling fewer miles away from their home city. We also found that fewer consecutive games played away were related to significantly more blocks of opponent shots (p = .02). Ultimately, the team shot significantly higher from the field when there were more days in between games (p = .03).
Conclusion: Findings from the present study reveal that certain aspects of team performance on the road appear to be influenced by miles traveled from the college's home city, consecutive games played away, and days in between games. Results could be applied beyond the current context, whereby college basketball teams could utilize such findings to mitigate the impact of travel on athletes.
Support (if any): None

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COGNITIVE DEFICITS DUE TO INSUFFICIENT SLEEP ARE MITIGATED FOLLOWING STRENUOUS PHYSICAL EXERTION IN FIREFIGHTERS

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Introduction: Insufficient sleep impairs cognitive function which results in costly errors. Firefighter shifts regularly exceed 24-hrs with little to no sleep. Nevertheless, firefighters must maintain and flexibly shift attention in high-pressure scenarios. Firefighters also engage in strenuous physical exertion during fire suppression activities. However, it is unclear whether physical exertion acts as another stressor, exasperating cognitive deficits due to insufficient sleep, or whether physical exertion enhances arousal to reduce cognitive deficits. Moreover, the effects of physical exertion may depend on the type of cognitive process and extent of sleep loss. We examined the effect of physical exertion on vigilant attention and task-switching in firefighters who underwent sleep-deprivation or sleep-disruption.
Methods: Participants were 17 healthy young adult males who participated in a within-subjects crossover design with three experimental lab visits: sleep-deprivation, sleep-disruption (woken 3 times for 60-min each), and normal sleep. The next day, participants completed a 50-min treadmill exercise task in a heated room in firefighter protective clothing. Participants completed a vigilant attention task (Psychomotor Vigilance Task, PVT) and a task-switching task five to nine times each visit. The five timepoints of interest–before and after the sleep manipulation night, before and after the treadmill exercise task, and recovery (approximately 180-min following exercise)–were examined using linear mixed effects models.
Results: We analyzed lapses (reaction times [RT]>500ms) on the PVT and switch-trial RT and accuracy on the task-switching task for sleep-deprivation and sleep-disruption conditions relative to normal sleep. Sleep-disruption, p=.001, and sleep-deprivation, p<.001, increased lapses. Sleep-disruption increased switch-trial RT, p=.01, and sleep-deprivation reduced switch-trial accuracy, p=.01. Only switch-trial accuracy improved immediately after the treadmill exercise task and only for the sleep-deprivation condition, p=.01. During recovery, lapses lessened for the sleep-deprivation condition, p=.049, and switch-trial accuracy improved for both sleep-deprivation, p=.01, and sleep-disruption conditions, p=.049.
Conclusion: Physical exertion reduced task-switching and attentional deficits caused by insufficient sleep, with more benefits observed during recovery. We found no evidence for performance decrements due to physical exertion. Physical exertion may interact with the extent of sleep loss–primarily benefitting performance under conditions of total sleep-deprivation.
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PILOT FIELD STUDY OF AMBULATORY SLEEP-STAGING IN SHIFT-WORKING AIR TRAFFIC CONTROLLERS

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Introduction: The simplicity of wrist actigraphy for sleep-wake monitoring in the field contributes to its ubiquity in shift-work research. However, devices based solely on recording activity levels are generally not suitable to quantify sleep architecture. This is a limitation as quantifying changes in sleep stages caused by circadian misalignment is important to better assess the consequences of sleep-wake disruption in shift-working populations. This pilot study was conducted to evaluate whether sleep stages vary with respect to different shift types.
Methods: Six male air traffic controllers aged 48.5±8.4 years (mean±SD) completed the protocol which entailed two ~9-day periods, each with up to 6 workdays. Schedules comprised 1 or 2 early night shifts (19:30–03:30h), followed by an evening shift (15:00–23:00h), day shift (09:00–17:00h), morning shift (06:30–14:30h), and 1 or 2 full night shifts (23:00–7:00h). A portable sleep-staging device (Somno-Art, Paris, France) that monitored activity levels and heart rate was worn on the non-dominant forearm during bedtime and produced estimates of REM and NREM sleep stages with a proprietary algorithm. Total sleep time (TST) and sleep stages were assessed per shift type with mixed-effects models.
Results: Final analyses were based on 70 sleep periods preceding workdays, standardized to 24 h to account for the different intervals between consecutive shifts. Analyses revealed significant effects of shift type for TST (p=.016), stages N1 (p=.010) and N2 (p=.043), but none for N3 (p=.055) or REM (p=.117) sleep. TST and stage N1 sleep prior to night shifts was shorter than for day, evening, or early night shifts (all p<.05). Participants obtained less stage N2 sleep prior to night shifts than days shifts (p=.049).
Conclusion: This pilot study suggests variations in TST across shifts were predominantly due to differences in light sleep stages, whereas no significant differences in N3 and REM sleep were observed. Thus, while TST was reduced for night shifts, participants obtained similar durations of the most recuperative stages. These findings highlight the importance of refined monitoring of sleep in field research involving shift-work.
Support (if any): Project funded by NAV Canada. Devices lent by the Somno-Art company. A.K. received a postdoctoral fellowship from the Fonds de Recherche en Santé du Québec (FRQS).

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PILOT SLEEP DURING BRAZIL-TO-CHINA COVID-19 HUMANITARIAN MISSION FLIGHTS COMPARED TO BIOMATHEMATICAL PREDICTIONS OF SLEEP

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Introduction: n response to the COVID-19 pandemic, Azul Airlines organized and conducted five separate humanitarian missions to China between May and July, 2020. Each mission consisted of 4 flight legs between 11-15 hours long crewed by a team of 8 pilots. Each pilot was given a 9-hour sleep opportunity during the flight period. Prior

to conducting the missions, a sleep-prediction algorithm (AutoSleep) within the Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE) model Fatigue Avoidance Scheduling Tool (FAST) was used to predict in-flight time in bed (TIB) and total sleep time (TST). During missions, pilots wore a wrist actigraph and completed a sleep diary. These analyses compare the accuracy of SAFTE-FAST AutoSleep predictions against pilots' sleep diary and actigraphy from Azul's COVID-19 humanitarian missions.

Methods: Pilots wore a sleep-tracking actigraphy device (Zulu Watch, Institutes for Behavior Resources), and reported the TIB and sleep quality of their in-flight rest periods using a sleep diary. Diary TST was estimated from TIB and sleep quality. AutoSleep, diary, and actigraphy measures were compared using paired samples t-tests. Agreement was compared using intraclass correlation coefficients (ICC).

Results: Twenty (n=20) pilots flying across 5 humanitarian missions provided sleep diary and actigraphy data. AutoSleep predictions of TIB (235±20 minutes) and TST (193±16 minutes) were significantly lower than diary (TIB: 330±123, t=6.80, p≤0.001; TST: 262±108, t=5.60, p≤0.001) and comparable to actigraphy (TIB: 246±127, t=0.78, p=0.43; TST: 212±113, t=1.59, p=0.12). ICC values were >0.90, indicating excellent agreement, for TIB (0.94) and TST (0.91).

Conclusion: Biomathematical predictions of in-flight sleep during unprecedented humanitarian missions were in agreement with actual sleep patterns during flights. These findings indicate that biomathematical models may retain accuracy even under extreme circumstances like the COVID-19 pandemic. Pilots may overestimate the amount of sleep that they receive during extreme flights-duty periods, which could constitute a fatigue risk.

Support (if any): NA

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EAST? I THOUGHT YOU SAID WEAST! THE INFLUENCE OF TRAVEL ON COLLEGE FOOTBALL TEAM PERFORMANCE

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Introduction: Previous research in professional basketball and baseball has shown that traveling up to three hours westward can hamper performance due to circadian disadvantages. However, findings in the context of collegiate football are conflicting, as some prior studies have reported negative effects on scoring during either eastward or westward travel. The current study extends the literature by investigating the impact of travel on both offensive and defensive team performance within National Collegiate Athletic Association (NCAA) Division I college football.

Methods: Following the NCAA's introduction of the College Football Playoff in 2014, data from 1,909 away games from 64 "Power Five" conference teams played during the 2014 to 2019 regular seasons were collected from the publicly available sports database, Sports-Reference. For the purposes of our analyses, we excluded all games played at neutral sites. We examined the effects of the direction of travel away from the college's home city and time of game day on visiting team performance, specifically game outcomes, points scored, points allowed, completion percentages, penalties, fumbles, interceptions, and total turnovers forced and committed, controlling for both visiting and home team conference, day of game, and team rankings.

Results: Teams playing in the afternoon allowed significantly more points (OR = 1.05, p < .001) and forced more opponent turnovers than those playing in the evening (OR = 1.14, p = .05). Teams traveling eastward threw significantly more interceptions than those traveling in the same time zone (OR = 1.48, p = .004). A significant interaction between direction of travel and time of day was detected for points allowed ($\chi2 = 12.30$, p = .02), and a marginal interaction was present for points scored ($\chi2 = 8.42$, p = .08). Several other marginal differences were also identified for points scored, interceptions, and team turnovers (OR > 1.03, p < .10).

Conclusion: Findings from our study offer evidence for the influence of circadian factors on team points allowed, interceptions, and opponent turnovers forced. Specifically, travel in varying directions and the time of day when a game is played can impact team performance during away games within college football.

Support (if any): None

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CHRONOTYPE-DEPENDENT IMPACT OF NAPPING ON SLEEP BEHAVIOR IN ROTATING SHIFT WORKERS

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Introduction: Rotating shift work is known to adversely impact sleep. Napping is one of the strategies that workers can use to mitigate the effect of shift work on their sleep. In this study, we investigated the effect of chronotype on napping behavior in police officers involved in rotating shift work.

Methods: Actigraphy-based sleep measures and chronotype information was available from 74 police officers (20 women and 54 men; age [mean ± SD]: 32 ± 5.4 years) that participated in a 35-day field study during which they worked morning, evening, and night shifts. A generalized linear mixed model was used to assess the effect of shift type, chronotype, and their interaction on the likelihood to take a nap, adjusted for relevant covariates. In addition, linear mixed models were used to determine the effect of shift type, chronotype, and their interaction on sleep duration with and without taking into account napping duration.

Results: The likelihood to take a nap was influenced by an interaction between shift type and chronotype ($\chi2(2) = 11.2$, p = 0.004). Earlier chronotype was linked to a lower likelihood to take naps during days with morning shifts and a higher likelihood during days with night shifts. Napping modulated the effect of shift type and chronotype on daily sleep duration, most notably during night shifts: while chronotype was associated with the duration of the main sleep period during night shifts, with the main sleep period being 1.7 h [95% C.I.: 0.6 – 2.8] shorter in the earliest chronotypes compared to the latest chronotypes, this effect was attenuated and no longer significant when napping duration was taken into account (difference in total sleep duration in latest chronotypes vs earliest chronotypes during nights shifts: 0.9 [−0.1 to 1.9] h).

Conclusion: Napping attenuates the chronotype-dependent effect of atypical work schedules on sleep duration in this population of shift-working police officers. These findings highlight the need to take into account chronotype when assessing the effect of shift work on sleep behavior.

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RACK CURTAINS IMPROVE SAILORS' SLEEPING CONDITIONS IN BERTHING COMPARTMENTS OF THE UNITED STATES NAVY (USN) SHIPS

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Introduction: Ambient light is one of the primary factors affecting sailor sleep in berthing compartments on USN ships. Each "rack" (i.e., bunk) has a curtain, however, intended only for privacy. Current rack curtain specifications do not address light-blocking properties. We assessed the effects of replacing existing, standard rack curtains with enhanced rack curtains that provide superior light-blocking in the sleeping environment.
Methods: Longitudinal (~2 weeks), naturalistic observation of sailors (N=52; 41 enlisted personnel) on a USN destroyer during deployment. The standard curtain was used for one week followed by one week with the enhanced light-blocking curtain. Sleep-related attributes (Epworth Sleepiness Scale–ESS, Insomnia Severity Index–ISI, Pittsburgh Sleep Quality Index–PSQI) were assessed at the end of each week. Actigraphy and rack temperature data (both inside and outside the rack) were collected throughout the study. Results are presented as median±median absolute deviation.
Results: Participants slept on average 6.8±1.0 hours/day. ESS scores improved with decreases from 9.0±3.0 with standard curtains to 7.0±3.0 with the enhanced curtains (p=0.020). Sailors with normal daytime sleepiness improved from 33 (63.5%) with standard curtains to 40 (76.9%) with the enhanced curtains. ISI scores decreased from 11.0±3.0 to 8.0±2.0 in the two conditions (p<0.001). The number of Sailors with ISI scores ≥15 decreased from 11 (21.2%) with standard curtains to 8 (13.5%) with the enhanced curtains (p=0.103). PSQI scores (8.0±2.0), however, did not change between the control and the intervention periods (p=0.527). Preliminary analysis showed that, compared to outside the rack, temperature inside the rack was slightly warmer on average with new curtains (~1 °F; p=0.096).
Conclusion: Our results suggest that the enhanced curtains reduced average daytime sleepiness and severity of insomnia symptoms. A greater difference in rack temperature with the enhanced curtains was observed; however, this may be attributed to the ship sailing in southern latitudes during the intervention period. Ongoing analysis will provide more insight on the utility of the enhanced curtains and their efficacy in improving sleeping conditions.
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DEPRESSION, ANXIETY, AND RESTING HEART RATE VARIABILITY DURING SLEEP IN A SAMPLE OF ACTIVE DUTY SERVICE MEMBERS

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Introduction: Depression and anxiety are among the most prevalent mental health outcomes in the military population with rates ranging between 11% and 15% in Army active duty service members (ADSMs). Oftentimes both maladies are comorbid with insomnia and other sleep-related disorders. We explored the association between self-reported depression and anxiety levels and resting heart rate variability (HRV) metrics during sleep using a wearable device, the Oura ring.
Methods: We conducted a longitudinal, naturalistic assessment of fit-for-duty ADSMs (N=44; 21-40 years of age, 38 males) attending the Naval Postgraduate School. Depression was assessed by the Beck Depression Inventory; anxiety was assessed by the State-Trait Anxiety Inventory. HRV (average nightly HRV and average nightly HRVmaximal during sleep) was assessed with the Oura devices during a period of MD=8 days (range 8–18).
Results: The median BDI score was 5.50 (IQR=9.50; range 0–23). Most participants had minimal depression (36, 81.8%) with seven (16.9%) having mild depression and one (2.27%) moderate depression. The median state anxiety score was 29.5 (IQR=16.8; range 20 – 56), whereas the median trait anxiety score was 31.0 (IQR=15.8; range 21–56). Correlation analysis (Spearman's rho) showed that lower depression and anxiety scores were associated with higher nightly HRV during sleep. Specifically, average nightly HRV was correlated with BDI scores (rho=-0.384, p=0.010), state anxiety scores (rho=-0.343, p=0.023), and trait anxiety (rho=-0.356, p=0.018). Average nightly HRVmaximal was negatively correlated with BDI scores (rho=-0.435, p=0.003), state anxiety scores (rho=-0.339, p=0.024), and trait anxiety (rho=-0.339, p=0.025).
Conclusion: Our findings suggest that HRV during sleep is associated with self-reported depression and anxiety levels in this sample of ADSMs. Further research is needed to assess the utility and limitations of the Oura devices to collect data in field settings.
Support (if any):

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A PILOT STUDY OF LIGHT MANAGEMENT IN THE US NAVY

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Introduction: Exposure to light at appropriate times can improve alertness and mood; however, light can also interfere with sleep if exposure occurs before bedtime. Therefore, light management is important for sailor well-being and operational performance. One approach to administer light in field settings is to use personal wearable devices. This pilot study assessed the challenges in using the blue-light blocking goggles (BLBG) and light emitting goggles (LEG) for crewmembers of a US Navy ship while underway.
Methods: Longitudinal (~2 weeks) assessment of sailors (N=18) during deployment. Sailors completed a questionnaire asking whether they used the devices, reasons (if any) they may have had for not using the devices, what they liked/did not like about the devices, and whether wearing the devices made a difference in terms of fatigue, alertness, ability to fall asleep, and reported sleep quality.
Results: Sailors reported that the LEGs seemed to increase alertness (n=8) and helped wake up faster (n=5), but the devices were bulky/heavy (n=9), too bright (n=4), and made it difficult to see in dim light (n=2). The reported reasons for not using the devices include: the devices were heavy/uncomfortable (n=5), they caused eye strain (n=4), and the LEGs interfered with sailor ability to see while on watch (n=3). Also, wearing the LEGs made sailors feel less tired (71%) and more alert (59%). Sailors reported that the BLBGs kept them drowsy before bed (n=3) and reduced eye strain (n=5). Sailors complained, however, that BLBGs were bulky/inconvenient (n=3). When not wearing the BLBGs, it was because the devices were easy to forget (n=2), sailors had to work after their shift (n=2), and other reasons (n=3). Wearing the BLBGs during watch made falling asleep easier (47%) and improved sleep quality (47%).
Conclusion: This study provided valuable insight regarding the use of personal wearable light management devices in field settings. Even though not conclusive, our results are promising. We will continue

assessing the utility of such devices with a goal of improving sailor well-being and operational performance.
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REST SCHEMES AND INFLIGHT SLEEP DURATION ON LONG RANGE AND ULTRA-LONG RANGE COMMERCIAL AIRLINE ROUTES

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Introduction: Pilots flying long range (LR; 8-16 hour) and ultra-long range (ULR; 16+ hour on 10% of trips) commercial airline routes use a variety of work/rest schedules during flights, resulting in a wide distribution of total inflight sleep time (TIFS) amounts. Since sleep is a strong predictor of performance, it is important to quantify TIFS and determine rest scheme patterns that optimize sleep opportunity and subsequent alertness and performance. Here we report rest schemes for pilots on LR and ULR routes and longer TIFS values than previously reported. These rest schemes can serve as templates to increase TIFS and improve pilot performance, particularly on ULR routes.
Methods: 427 commercial airline pilots provided data for this substudy that was part of a larger study on Fatigue Risk Management System (FRMS) routes. Inflight sleep timing and duration were measured on 3 LR and 5 ULR routes. Inflight sleep times were self-reported in a sleep/work logbook and verified using actigraphy.
Results: Most outbound and inbound landing crews took one break during the second half of the flight (average LR TIFS=4.0 hr; average ULR TIFS=4.9 hr), while most outbound and inbound relief crews consequently took one break during the first half of the flight (average LR TIFS=3.5 hr; average ULR TIFS=4.5 hr). However, three of the five ULR routes used more complex split rest schemes for landing and relief crews, primarily on outbound flights (average TIFS=5.0 hr). Across all routes and both crews, the maximum average TIFS reached ~6 hours.
Conclusion: Our results indicate that pilots on average are sleeping inflight more than previous studies demonstrated. Additionally, we found that crews on some ULR flights used more complicated rest schemes, but still generally preferred 2 or 3 breaks. These findings have implications for airline procedures and aviation policies by showing that pilots may be sleeping longer than originally expected on LR and ULR flights. Recommending rest schemes that allow for the greatest inflight sleep opportunity may provide the best chance for inflight recuperation, especially before the Top of Descent critical phase of flight.
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PREDICTIVE UTILITY OF A BRIEF SCALE TO IDENTIFY U.S. ARMY SOLDIERS WHO ARE GENETICALLY VULNERABLE AND RESILIENT TO SLEEP LOSS

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Introduction: Sleep loss that is inherent to military operations can lead to cognitive errors and potential mission failure. Single Nucleotide Polymorphisms (SNPs) allele variations of several genes (COMT, ADORA2A, TNFa, CLOCK, DAT1) have been linked with inter-individual cognitive resilience to sleep loss through various mechanisms. U.S. Army Soldiers with resilience-related alleles may be better-suited to perform cognitively-arduous duties under conditions of sleep loss than those without these alleles. However, military-wide genetic screening is costly, arduous, and infeasible. This study tested whether a brief survey of subjective resilience to sleep loss (1) can demarcate soldiers with and without resilience-related alleles, and, if so, (2) can predict cognitive performance under conditions of sleep loss.
Methods: Six SNPs from the aforementioned genes were sequenced from 75 male U.S. Army special operations Soldiers (age 25.7±4.1). Psychomotor vigilance, response inhibition, and decision-making were tested after a night of mission-driven total sleep deprivation. The Iowa Resilience to Sleeplessness Test (iREST) Cognitive Subscale, which measures subjective cognitive resilience to sleep loss, was administered after a week of recovery sleep. A receiver operating characteristic (ROC) curve was used to determine whether the iREST Cognitive Subscale can discriminate between gene carriers, and a cutoff score was determined. Cognitive performance after sleep deprivation was compared between those below/above the cutoff score using t-tests or Mann-Whitney U tests.
Results: The iREST discriminated between allele variations for COMT (ROC=.65,SE=.07,p=.03), with an optimal cutoff score of 3.03 out of 5, with 90% sensitivity and 51.4% specificity. Soldiers below the cutoff score had significantly poorer for psychomotor vigilance reaction time (t=-2.39,p=.02), response inhibition errors of commission (U=155.00,W=246.00,p=.04), and decision-making reaction time (t=2.13,p=.04) than Soldiers above the cutoff score.
Conclusion: The iREST Cognitive Subscale can discriminate between those with and without specific vulnerability/resilience-related genotypes. If these findings are replicated, the iREST Cognitive Subscale could be used to help military leaders make decisions about proper personnel placement when sleep loss is unavoidable. This would likely result in increased safety and improved performance during military missions.
Support (if any): Support for this study came from the Military Operational Medicine Research Program of the United States Army Medical Research and Development Command.

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IMPACTS OF TRAVEL AND TIME ZONE DIFFERENCES IN THE NATIONAL HOCKEY LEAGUE (NHL)

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Introduction: Elite athletes are at risk of poor sleep which can be exacerbated by frequent travel. The present exploratory study investigated the impact of travel on the winning percentage, number of goals scored in the 3rd period and the number of penalties in the 3rd period over the 2013–2020 seasons in the National Hockey League (NHL).
Methods: Data from away and home games from the 2013–2020 seasons in the NHL were included in this study. The outcomes were based on winning percentage with additional covariates including home and away games; timing of the game (afternoon/17:30 or earlier; evening/18:00 or later; number of time zones travelled (one, two or three); direction of the travel (eastward or westward); length of the game (regular, overtime or shootout). Additionally, data exclusively from the 3rd period were assessed for the number of penalties received and the number of goals scored for and against. Data were analyzed with logistic regressions to evaluate the effects of the aforementioned

variables on winning percentage for both eastern and western conference teams.
Results: Regardless of the length of the game, results indicated no difference between eastern and western teams on winning percentage. However, there was a significant impact of home-ice on winning percentage for both conferences ($p<0.001$). In addition, there was no difference on the winning percentage based on the travel direction and the number of time zones crossed ($p = 0.747$) or the time of the day ($p=0.991$). Moreover, visiting teams received significantly more 3rd period penalties than home teams ($p<0.001$), regardless of travel and while travelling within the same time zone compared to eastward travel ($p<0.001$) but not westward travel ($p=0.078$). Finally, there was an increased risk of being scored against when team travelled three time zones ($p=0.03$), regardless of the direction.
Conclusion: This 7-year investigation of data from the NHL demonstrates an unexplored aspect of the impact that travel and circadian factors may have on emotion regulation and performance. Translational application of this knowledge to enhance general public health and performance would be warranted.
Support (if any):

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IMPACTS OF TRAVEL DISTANCE AND TRAVEL DIRECTION ON BACK-TO-BACK GAMES IN THE NATIONAL BASKETBALL ASSOCIATION (NBA)

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Introduction: Travel fatigue and circadian disruptions are known factors that can hinder performance in professional athletes. The present exploratory study focused on investigating the impact of travel distance and direction on back-to-back games over the 2013–2020 seasons in the National Basketball Association (NBA).
Methods: Data from away and home games of back-to-back sequences, in two different cities, from the 2013 to 2020 seasons in the National Basketball Association were included in this study. Information from every selected game was retrieved from the official website of the NBA (www.nba.com). The outcomes were based on winning percentage with additional covariates including the direction of travel (eastward or westward) and the distance travelled (0-500km – 501-1000km – 1001-1500km – 1501km and more). If a team played both games of a back-to-back sequence on the road, they were considered Away-Away; if a team played the first game of a back-to-back sequence at home they were considered Home-Away; if a team played the first game of a back-to-back sequence on the road they were considered Away-Home.
Results: The sequence Away-Home significantly increases the likelihood of winning compared to the Away-Away and Home-Away sequences 54.4% (95%CI: 54.4,54.5); 39.2% (95%CI: 37.2,41.2), and 36.8%, (95%CI: 36.7,36.8), respectively. Following a road game, when teams travel back home, every additional 500km reduces the likelihood of winning by approximately 4% ($p = 0.038$). Finally, after withdrawing the Away-Home sequence, travelling eastward significantly increases the chance of winning ($p = 0.024$) compared to westward travel but has no significant impact on the probability of winning compared to neutral time zone travel ($p = 0.091$).
Conclusion: The accumulation of travel fatigue and the chronic circadian desynchronization that occurs over the NBA season can acutely disturb sleep and recovery. It appears that tailored sleep and recovery strategies need to be dynamically developed throughout the season to overcome the different challenges of the NBA schedule.
Support (if any):

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SEX DIFFERENCES IN SLEEP AND WAKEFULNESS OF POLICE OFFICERS WORKING SHIFTS: EVIDENCE FROM A FIELD STUDY

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Introduction: National reports of work-related injuries found the excess risk of work injury attributed to shift work to be significantly higher among women. The Working Time Society (WTS) concluded that male sex is one of the few factors that is "consistently associated with perceived or actual shift work tolerance". However, it is unclear if physiological parameters are involved. Laboratory-controlled studies report sex differences in circadian rhythms (body temperature, melatonin). In sleep deprivation protocols, alertness and cognitive performances were affected by sex, menstrual cycle phase and hormonal contraceptives [HC] use. Nevertheless, field studies that compare male and female shift workers are scarce.
Methods: An observational study including 76 police officers working on patrol: 56 males and 20 females (11 using [HC], 6 not using [non-HC] and 3 with unknown use of hormonal contraception) aged 32.0 ± 5.3 years. Participants were followed throughout a month-long work cycle (1,457 morning, evening, night, or other shifts, plus rest days). They filled out time-stamped questionnaires (Samn-Perelli, KSS, Visual Analogue Scales, ~5/day; sleep and work-related information, ~1–2/day), completed 5-min Psychomotor Vigilance Tasks (PVT, ~2/day), and wore an actigraph to collect activity data. Linear mixed-effects models were used to analyze the effects of group, time awake and time-of-day on fatigue, sleepiness, alertness, mood and PVT measures.
Results: Self-reported measures and psychomotor performance significantly varied with time awake and time-of-day. Fatigue and sleepiness levels were significantly higher among female compared to male police officers, both with time awake and across the 24-h day. These variations were similar between non-HC females and the other groups. Compared to males, HC females were more fatigued and less alert, both with time awake and across the 24-h day, and sleepier with time awake. Having children at home did not explain these differences.
Conclusion: The results of this study expand our knowledge on the sex differences in the sleep and circadian physiology and demonstrate a critical effect of HC on women fatigue, sleepiness and alertness when working shifts. Sex and hormonal parameters must be considered in occupational medicine as well as in future laboratory and field studies on shift workers and circadian rhythms.
Support (if any): IRSST, FRQS.

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THE RELATIONSHIP BETWEEN SLEEP AND OBJECTIVELY MEASURED SEDENTARY BEHAVIOR IN ADULTS WITH DESK JOBS

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Introduction: Both poor sleep and sedentary behavior lead to negative health outcomes. While some previous studies have observed an association between poor sleep and greater sedentary behavior, few studies have assessed this relationship using an objective measure of sedentary behavior. We examined the association of both self-reported and objectively-measured sleep with objectively-measured sedentary behavior.
Methods: In a secondary analysis of baseline data from an ongoing clinical trial, the present analysis included 157 physically inactive adults with elevated blood pressure (120–159 mmHg systolic or 90–99 diastolic) and desk jobs (82.8% white, 65.6% female, age 45.5±12.0). To assess sedentary behavior, participants wore an accelerometer/inclinometer (activPAL3 micro) on the upper thigh continuously for 7 days. Variables included total sedentary time, prolonged sedentary time (≥30 minute bouts), and sit-to-stand transitions; these were averaged across all waking hours as well as the workday. To assess sleep, participants completed the Pittsburgh Sleep Quality Index (PSQI) and a subsample (n=57) wore an Actiwatch Spectrum for 7 nights. Variables examined included the PSQI global score, actigraphy-based total sleep time (TST) and sleep efficiency (SE). Linear regression examined associations between sleep and sedentary behavior, with adjustments for age, gender, race, body mass index, and activPAL3 wear time.
Results: Participants had (mean±standard deviation) 11.1±1.5 hours sedentary time per day, with 6.3±2.0 occurring in ≥30 minute bouts, and 51.3±13.4 sit-to-stand transitions. During the workday, participants had 6.6±1.3 hours sedentary time with 3.8±1.7 occurring in ≥30 minute bouts and 27.2±11.2 sit-to-stand transitions. PSQI global score was 4.9±2.9; 32.5% were classified as poor sleepers. Actigraphic TST was 6.7±0.8 hours, with SE of 85.4±6.3%.Greater SE was associated with less sit-to-stand transitions during the workday (β=-0.36, p=0.01) and during the full day (β=-0.37, p=0.01). Subjective sleep quality and actigraphic TST were not associated with sedentary behavior.
Conclusion: We did not find a cross-sectional association between sedentary behavior and sleep in insufficiently active adults, potentially due to restricted range of sedentary behavior and physical activity in the sample. The association between greater sleep efficiency with fewer sit-to-stand transitions is counterintuitive and warrants further exploration.
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SLEEP STABILITY AND ACADEMIC PERFORMANCE IN COLLEGE STUDENTS

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Introduction: There is considerable research demonstrating poor sleep patterns in college students; however, few studies actually examine sleep stability over a typical undergraduate career. Considering that the transition to college involves significant shifts in independence and potentially creating a foundation of lifelong behavioral patterns, it is important to identify whether these poor sleep patterns change throughout college. Additionally, studies show that shorter sleep duration predicts poorer academic performance. In the current study, it was expected that students would report poor sleep on average, and that poorer sleep would predict worse academic performance.
Methods: Participants included 27 full-time first-year undergraduate students who completed an online survey every spring for four years to examine sleep habits as part of a larger longitudinal study on the transition to college at a small liberal arts school. The Pittsburgh Sleep Quality Index was used to assess total sleep time (TST), sleep efficiency, and quality; the Epworth Sleepiness Scale (ESS) was used to determine sleepiness. Semester GPA was obtained via college registrar records.
Results: Repeated measures ANOVAs revealed no differences in participants' sleep variables (TST, sleep quality, sleep efficiency, and sleepiness) across all four time points. Average TST was 6.85 hours per night, and overall sleep quality (PSQI) was poor (M = 6.12). Mean sleep efficiency was 86.70%; mean ESS score was 5.35. Preliminary analyses revealed no significant differences between GPA values over the course of the four years; sleep factors did not predict GPA.
Conclusion: Overall, students reported short sleep, poor sleep quality, decent sleep efficiency, and borderline higher than normal daytime sleepiness. However, sleep factors and GPA were stable over all time points. These results suggest that poor sleep habits start early and continue throughout students' college career, as opposed to developing throughout college, or starting out poor and improving. Surprisingly, preliminary results indicated that sleep factors did not predict academic performance. Limitations include subjective sleep assessments, limited testing, and small sample size; however, this longitudinal study sheds interesting light on the general sleep patterns of college students over the course of their entire academic career.
Support (if any): None.

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LIMITED TIME FOR SLEEP IN NIGHT SHIFT WORKERS IS ASSOCIATED WITH RISK OF INSOMNIA AND SHIFT WORK DISORDER

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Introduction: Sleep deficiency is a severe problem faced by night shift workers. Approximately one-third of night workers report insomnia during daytime sleep and excessive sleepiness during nighttime work; when severe, these symptoms characterize shift work disorder (SWD). Difficulty sustaining 7 to 9 hours of sleep during the daytime is partly due to a circadian drive for wakefulness. Not much is known, however, about how non-work activities contribute to the inability to obtain recovery sleep. We sought to explore how much time night workers are able to allocate for daytime sleep, and how this relates to insomnia-like symptoms and the likelihood of developing SWD.
Methods: Night shift workers (n=452, 19–69 years old, 54% men) from various occupations who worked at least four night shifts per month completed an online survey. This included questions related to shift duration, hours per workday of non-optional non-work activities, self-rated sleep need, the Insomnia Severity Index (ISI) and a validated 4-item SWD screening questionnaire. For each participant, we calculated the duration of work plus non-optional activities and compared the remaining available time for sleep to their self-described sleep need. Non-parametric Chi-square analyses and Pearson correlations were conducted.
Results: On average, shift duration was 8.9±1.6 hours, non-optional activities were 3.6±2.9 hours, and sleep need was 7.6±1.6 hours, leaving 15% of shift workers with insufficient free time to obtain the amount of sleep they needed. The percentage of workers at high risk for SWD was significantly greater among those who did not have enough free time for sleep compared to those whose schedules allowed sufficient sleep time (72% vs. 42%; $\chi 2=20.2$, $p<0.0001$). We also found that shift workers with insufficient free time for sleep reported higher insomnia severity ($r2=-0.20$, $p<0.0001$).

Conclusion: About 15% of night workers have non-optional activities outside work that limit their time to obtain sufficient sleep, and this contributes to greater insomnia-like symptoms and increased risk for SWD. Future research should focus on understanding what these non-optional activities are and whether they differ between night and day workers. These insights will enable personalized countermeasures to maximize the sleep and health of shift workers.
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THE USE OF SLEEP AIDS IN YOUNG ATHLETES AND NON-ATHLETES: AN EXPLORATORY STUDY

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Introduction: Studies have shown that sleep in adolescents is characterized by sleep disturbances. Many teens resort to prescribed or nonprescribed medication to alleviate their sleep difficulties. Research suggests that sport and physical activity may be protective factors regarding sleep. The aims of the present study were to investigate the use of sleep aids among young athletes and non-athletes, and to identify possible factors associated with prescribed and nonprescribed sleep aids
Methods: 35 young athletes (14.6±0.7 years old; 54.3 % males) and 30 young non-athletes (15.1±0.7 years old; 16.7% males) completed questions on sleep aids, the Academic Motivation Scale, the anxiety and depression scales of the Beck Youth Inventory-II, and the Multidimensional Self-Esteem Questionnaire, at the beginning, middle, and end of the school year. Mean scores for the school year were computed for amotivation in school, intrinsic academic motivation of accomplishment, self-esteem, anxiety symptoms, and depressive symptoms. Teens were each categorized as user or non-user if they had or had not used sleep aids during the school year. First, comparison of sleep aids usage between groups were done using a Chi-square test. Then, both groups of athletes and non-athletes were combined. Amotivation, intrinsic motivation, self-esteem, and anxiety and depressive symptoms were compared between users and non-users using paired t-tests
Results: Results show that young non-athletes report using sleep aids more often than young athletes (X2(1,N=65)=5.205, p=.023). Indeed, 65.2% non-athletes compared to 34.8% athletes reported using sleep aids during school year. Users represent 35.4% of the total sample. T-tests showed that users have a significantly higher amotivation score (t(65)=-2.010, p=.049), more anxiety symptoms (t(65)=-2,480, p=.016), and more depressive symptoms (t(65)=-2,126, p=.037) than non-users.
Conclusion: These results show a high prevalence of prescribed and nonprescribed sleep aids usage in teens. Our results also suggest that sleep aids in young adolescents is associated with mental health problems and academic motivation issues. On the other hand, our results support that sport and physical activity may have a protective role regarding sleep. This highlights the importance to promote sport participation among adolescents.
Support (if any): n/a

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EVALUATION OF FATIGUE AND HEALTHY LIFESTYLE PRACTICES AMONG NEW YORK STATE LAW ENFORCEMENT PROFESSIONALS

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Introduction: An important risk factor for drowsy driving is shift work, and law enforcement, an occupation known for its atypical work schedules, is a highly vulnerable occupation. A connection between fatigue and unintentional injuries among police officers has been observed (Vila, 2006), but data supporting the connection is limited. Understanding how sleep and lifestyle practices impact this population's driving performance and job safety is critical to officer safety.
Methods: An online survey was disseminated to New York State law enforcement agencies by the Governor's Traffic Safety Committee to assess sleep health and lifestyle practices among law enforcement personnel. Statistical analysis included data cleaning, basic and advanced statistical testing.
Results: 7,366 survey invitations were distributed, 1,171 were returned (15.9% response rate), and after data cleaning, 1,038 surveys were included in the analysis. Respondents reported from various state, county, and local agencies, holding titles from Police Officer to Senior Management. More than 30% of officers reported driving 5 hours or more during their shift, with 12% driving greater than 7 hours. 65% of respondents reported having experienced drowsy driving. Although, 34% reported never having received education about drowsy driving. On work days, only 40% of respondents obtain 7 hours of sleep or more. On days off, 23.6% reported sleeping 6 hours or less. Work, stress, and family responsibilities were reported as having a significant impact on sleep. Almost 87% reported at least one medical issue. Daytime sleepiness (47.4%), fatigue (42.6%), and poor memory (26.8%) were reported daily. Only 23.8% and 29.3% of respondents received education on sleep or heart health, respectively. The majority (81.7%) reported they would consider education in a variety of health-related programs.
Conclusion: Our findings indicate that poor sleep (60%), high stress (22.7%), and anxiety (16.8%) are a concern amongst officers. Poor cardiovascular health was also noted, based on reports of obesity (34.1%), high blood pressure (23.5%), and high cholesterol (22.4%). This research supports the need for prioritizing health education programs within law enforcement agencies.
Support (if any): Funded by The National Highway Traffic Safety Administration with a grant from The New York State Governor's Traffic Safety Committee.

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SLEEP, SLEEPINESS, AND PERFORMANCE ACROSS THREE IN-FLIGHT BUNK REST OPPORTUNITIES

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Introduction: Airline pilots are required to take a rest break in a bunk during long-haul flights in an effort to reduce sleepiness during critical phases of flight. It is unclear, however, whether each rest break affords equal opportunity for sleep. We aimed to characterize sleep, sleepiness, and performance outcomes across three in-flight rest breaks during long-haul flights.
Methods: Thirty-seven pilots wore actiwatches and completed sleep diaries for approximately two weeks while flying a variety of long-haul routes (n=126 flights). Self-reported in-flight bunk rest (BR) periods were used to set rest intervals and sleep was estimated within these intervals using actigraphy software (wake threshold set to medium). Pilots provided Karolinska Sleepiness Scale ratings (KSS) and performed a 5-minute psychomotor vigilance task (PVT) before landing. A linear mixed-effects model with participant included as a random effect and allowed to vary by intercept was used to assess differences between BR opportunities.
Results: The majority (97%, n=122) of BR periods contained sleep (as estimated by actigraphy). The mean (+/- standard deviation) sleep

duration for the first, middle, and third BR opportunity was 152.8 (69.7), 149.2 (44.1), 125.2 (44.9) minutes, respectively. There was a significant effect of BR opportunity for sleep duration ($F(2,54) = 3.747$, $p=.03$) and KSS ($F(2,44) = 7.869$, $p=.001$). Bonferroni adjusted planned pairwise contrasts revealed that pilots using the third BR obtained significantly less sleep than in the first BR ($p=.029$). KSS ratings prior to landing were higher for the third BR compared to both the first ($p=.001$) and middle BR ($p=.017$). There were no significant differences for PVT speed or lapses (all $p>05$).

Conclusion: These results suggest that the last rest break is associated with shorter sleep, lower alertness, and no differences in performance relative to the other rest breaks. Further analysis is required to determine whether the higher KSS ratings following the third rest break are associated with sleep inertia, or whether other factors may be involved.

Support (if any): NASA Airspace Operations and Safety Program, System-Wide Safety Project

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SLEEP MIDPOINT AND EFFICIENCY MODERATE THE LINK BETWEEN STRESS AND ACADEMIC COGNITIONS IN LATINX COLLEGE STUDENTS

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Introduction: Latinx students are the largest ethnic/racial minority group in higher education, but are also the group least likely to graduate from a four-year institution. Research suggests that heightened stress perceptions may impede college students' ability to perform well academically. Poorer sleep may compound the impact of stress on academic functioning. The present study examined the multiplicative effect of college-stress and actigraphy-measured sleep on academic cognitions within-and-across semesters.

Methods: 209 Latinx college students (Mage=18.95; 64.4% female, 85.1% Mexican descent) were assessed in the spring of the first year of college (T1) and fall of the second year (T2). At T1, participants wore an actigraph watch for 7 nights to measure total sleep time, sleep efficiency, and sleep midpoint. College-stress was assessed at T1 using the College Stress Scale. At T1 and T2, participants completed the Behavioral-Emotional-Cognitive School Engagement Scale, the Academic Self-Efficacy Scale, and a scale assessing academic motivation. Confirmatory factor analysis (CFA) was conducted to assess the model fit of a two-factor model representing academic cognitions (engagement, self-efficacy, motivation) at T1 and T2. Latent variable path analysis models testing for moderation were conducted using Mplus.

Results: The CFA indicated excellent fit ($\chi2(5)= 2.91$, $p=.71$, RMSEA=.00, CFI=1.00, TLI=1.01, SRMR=.02). College-stress was concurrently ($\beta=-.19$, $p=.02$), but not longitudinally, associated with academic cognitions. Sleep midpoint predicted academic cognitions at T1 ($\beta=-.24$, $p<.01$) and T2 ($\beta=-.18$, $p=.03$). Sleep efficiency ($\beta=.18$, $p=.01$) and sleep midpoint ($\beta=-.17$, $p=.02$) moderated associations between college-stress and T2 academic cognitions. Higher college-stress was longitudinally linked with lower academic cognitions for students with lower sleep efficiency ($b=-.12$, $p=.01$) and later sleep midpoints ($b=-.14$, $p=.01$).

Conclusion: Greater college-stress is concurrently linked with lower academic cognitions, whereas later sleep timing has both immediate and enduring consequences on students' academic mindsets. The impact of college-stress on academic cognitions may depend on the quality and timing of sleep at the time of these stress perceptions. Programs that address stress reduction and sleep health may be promising interventions for improving academic well-being among first-year Latinx college students.

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THE RELATIONSHIP BETWEEN BASIC PERSONALITY, SUBJECTIVE SLEEP DURATION, AND PSYCHOLOGICAL DISTRESS DURING A MILITARY DEPLOYMENT

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Introduction: Extended, overseas operations (deployments) increase the likelihood that military personnel will experience psychological distress. Reduced sleep during deployments is a key correlate of psychological distress. Thus, it is imperative to identify mechanisms that adaptively modulate the relationship between insufficient sleep and psychological distress. Research has recently connected basic personality traits (i.e., the Big Five: extraversion, agreeableness, conscientiousness, neuroticism, and openness) to more sleep. The current project aimed to examine the relationship between basic personality traits, subjective sleep duration (SSD), and psychological distress during an operational deployment.

Methods: 488 soldiers took surveys both prior to and half-way through a nine-month deployment. The pre-deployment survey included the Big Five Index, and three standardized measures of psychological distress commonly used to screen military personnel for anxiety (Generalized Anxiety Disorder; GAD-7), depression (Patient Health Questionnaire; PHQ-8), and post-traumatic stress (Posttraumatic Symptom Disorder Checklist; PCL-4). The mid-deployment survey included an item from the Pittsburgh Sleep Quality Index measuring SSD and the same psychological distress measures from the pre-deployment survey. General linear models were used to test the interaction between SSD and each basic personality trait on each measure of psychological distress at mid-deployment while accounting for psychological distress at pre-deployment.

Results: Of the Big Five, conscientiousness was the only trait to significantly moderate the relationship between SSD and anxiety, $t = 2.11$, $p = .035$, where higher conscientiousness weakened the relationship. Further only agreeableness attenuated the relationship between depression and SSD, $t = 2.10$, $p = .036$. Interestingly, the only Big Five trait that moderated the relationship between SSD and PTS was openness, insomuch that openness strengthened the relationship, $t = -1.92$, $p = .055$.

Conclusion: The relationship between SSD and psychological distress was uniquely impacted by different personality traits. These results reinforce the age-old concept that behavior is the product of a complex, nuanced, and puzzling interaction between the individual and the environment. The current research motivates further research into personality as an adaptive mechanism for optimizing military wellbeing.

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SUBJECTIVE SLEEP PREDICTS CADET PERFORMANCE DURING U.S. ARMY RESERVE OFFICER TRAINING CORPS ADVANCED CAMP

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Introduction: U.S. Army Reserve Officer Training Corps (ROTC) Advanced Camp (AC) is a 29-day training that assesses military skills and leadership potential in college students training to become Commissioned Officers (i.e. Cadets). Military trainings are widely known to disrupt normative sleep. Additionally, operational sleep disruption is linked to performance decrements. This study examined the ability for objective and subjective sleep during ROTC AC to predict Cadet performance.
Methods: One hundred and fifty-nine ROTC Cadets (age 22.06±2.49 years; 76.1% male) wore an actiwatch device continuously for 29 days during AC. Paper surveys administered at the end of AC captured subjective sleep metrics during the training. ROTC instructors evaluated Cadet performance and provided scores of overall class rank and summary performance. Multiple and ordinal linear regressions assessed the predicative utility of subjective (sleep duration [SD]; Global score [Global] from the Pittsburgh Sleep Quality Index) and objective (Total Sleep Time [TST]; Sleep Efficiency [SE]; Sleep Latency Onset [SOL]; Wake After Sleep Onset [WASO] from actigraphy) sleep on performance.
Results: The interaction of SD and Global, when controlling for age and gender, significantly predicted increased Cadet rank, $F(4,153) = 3.09$, $p = 0.018$. Models testing the prediction of SD and Global on summary performance score were non-significant. Further, regressing of both Cadet rank and summary performance individually on objective sleep metrics, when controlling for age and gender, resulted in non-significant findings.
Conclusion: Subjective and objective sleep showed no significant individual predictive utility on performance. However, the combined subjective model significantly predicted that Cadets who slept worse (lower SD; higher Global) during AC received a lower rank at the end of the training. These findings suggest there may be a unique combined predictive utility of subjective sleep on performance when compared to the predictive power of individual variables. Therefore, subjective sleep may be better for predicting operational performance than objective sleep. Future analyses will refine these models and examine how performance on individual AC events may be influenced by sleep.
Support for this study came from the Military Operational Medicine Research Program (MOMRP) of the United States Army Medical Research and Development Command (USAMRDC).
Support (if any):

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CIRCADIAN ACTIVITY RHYTHMS AND ALERTNESS AMONG RAPID-SHIFT WORK FEMALE NURSES

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Introduction: Circadian rhythms play an important role in regulating sleep. Sleep disturbances are prevalent in shift-work nurses, particularly for those work in rapid-shift rotation, including night shifts and day shifts. This study aimed to: 1) describe the characters of sleep-wake index (total sleep time [TST], wake after sleep onset [WASO], circadian activity rhythms [CAR]), psychomotor vigilance test (PVT), salivary cortisol, fatigue, and activity level during 8- and 12-hour rapid-shift work nurses; and 2) compare the parameters between two different shifts.
Methods: This exploratory study used registered nurses (RNs) from nine intensive care units in Beijing area. 7-days consecutive wrist actigraphy data, including TST and WASO were collected. Cosiner analysis was used for computing the CAR, including amplitude and mesor. PVT and saliva cortisol were used to assess alertness level, which measured before and after shift. Self-reported fatigue severity was measured by Lee Fatigue Scale-Short Form and assessed before and after shift.
Results: A total of 152 RNs (12-hour, n=82; 8-hour, n=70) participated this study, with a mean age of 31.81 (SD= 6.09). Compared with the 8-hour shift nurses, the 12-hour shift nurses were significantly higher in TST (456 vs. 364 minutes), median saliva cortisol level (before day shift, 0.54 vs. 0.31), and median PVT reaction time (before night shift). However, CAR were 0.53 (SD=0.13) and 0.50 (SD=0.18) for 12-hour and 8-hour shift RNs, respectively, and indicates desynchronized CAR in both groups. Regardless shift rotation, almost three-quarters of the RNs had a 500 ms PVT reaction time. For the 12-hour and 8-hour nurses, the level of activity during day shift was similar. However, during night shift work it was significantly lower in 12-hour nurses compared to the 8-hour nurses. All RNs experienced clinical significant fatigue severity (ranged 3.78 to 8.14) regardless before or after shift work; however, the 12-hour group reported lower fatigue severity than 8-hour group.
Conclusion: In this study, findings revealed shift-work RNs experienced fatigue and desynchronized CAR. The TST was low and reaction time was prolonged before and after shift work. Sleep intervention should be mandatorily included in clinical continue education.
Support (if any): This project was supported by Chinese National Natural Science Foundation (71603279).

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SLEEP AND OCCUPATIONAL WELLBEING IN ACTIVE DUTY U.S ARMY SOLDIERS

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Introduction: Insufficient sleep is ubiquitous among active duty service members in operational settings. Although insufficient sleep has been linked to poor cognitive, psychological, and physiological outcomes in military populations, little research has investigated the impact of insufficient sleep on Soldier occupational wellbeing. This study examined the longitudinal association between sleep quality and occupational functioning in a population of active duty U.S. Army Soldiers.
Methods: Sixty male Soldiers (age 25.41±3.74 years) participated. Sleep quality and occupational outcomes were assessed four weeks apart (before and after an annual training mission). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). Occupational outcome measures included the Emotional Exhaustion Scale, Walter Reed Functional Impairment Short Scale, Role Overload Scale, and Perceived Stress Scale. Linear regressions assessed the prediction of PSQI Global Score on occupational outcome scores. Student's t-tests compared occupational outcomes between "good" and "poor" sleepers (PSQI Global Score > 5 = poor sleeper).
Results: Poorer sleep quality at baseline broadly predicted poor occupational outcomes post-training. Specifically, higher PSQI Global Scores predicted higher emotional exhaustion ($B = 1.6$, $p < 0.001$, $R2 = 0.25$), functional impairment ($B = 0.29$, $p < 0.03$, $R2 = 0.14$), role overload ($B = 28$, $p < 0.008$, $R2 = 0.12$), and perceived stress ($B = 0.34$, $p < 0.004$, $R2 = 0.2$). Furthermore, occupational outcome scores were significantly higher in poor sleepers than good sleepers:

emotional exhaustion: ($t(58) = -4.18$, $p < .001$); functional impairment: ($t(59) = -3.68$, $p = .001$); role overload ($t(58) = -3.20$, $p = .002$); and perceived stress ($t(58) = -2.43$, $p = .02$).

Conclusion: This study identified a longitudinal relationship between sleep quality and occupational outcomes, suggesting that service members with poor sleep may be at risk for experiencing poor workplace wellbeing. Given the association between service member wellbeing and likelihood to re-enlist, insufficient sleep may negatively impact Soldier attrition. Future studies should aim to augment sleep quality and track occupational outcomes in this population.

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SLEEP QUALITY PREDICTS DISCREPANCY BETWEEN OBJECTIVE AND SELF-RATINGS OF PERFORMANCE IN CADETS DURING U.S ARMY ROTC ADVANCED CAMP.

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Introduction: U.S. Army Reserve Officer Training Corps (ROTC) Advanced Camp (AC) is a month-long capstone course that evaluates Cadet leadership. Although the relationship between sleep and objective performance is well established, less is known about how sleep may impact self-perception of performance, especially in the military context. This study examined the impact of habitual sleep on self-expected and objective AC performance.

Methods: 577 Cadets (age 22.22 ± 2.74; 74.36% male) completed the Pittsburgh Sleep Quality Index (PSQI) at baseline to measure subjective sleep quality (Global; higher scores indicate poorer sleep quality) and total sleep time (TST) in the month before training. Self-expected AC performance was captured by asking Cadets to estimate what their final performance score would be and objective performance was determined from summary scores from Instructors. Performance discrepancy was calculated as the difference between Cadet's expected and objective scores. Regression models assessed the predictive utility of habitual TST and Global on performance.

Results: Ordinal regressions showed that as Global increased, expected AC score also decreased with an OR of .684 (95% CI, -.694 to -.064), Wald $\chi2(1) = 5.56$, $p = .018$. Further, Global independently predicted performance discrepancies, where the odds of a difference existing between a Cadet's self-expected and their objective performance was .895 less likely for those with increasing Global ($p = .028$). Together TST and Global predicted discrepancy magnitude between Cadet self-expected and objective performance, $F(2, 349) = 2.99$, $p = .05$, with Global as a independent predictor $p < .05$. Independent findings related to TST were varied and warrant further testing.

Conclusion: Cadets with poorer sleep quality prior to AC self-expected to perform worse and had discrepancies between their self-expected and objective performance when compared to those with higher sleep quality. TST enhanced the predictive power of Global when predicting magnitude of performance discrepancy. Therefore future research examining Global, while accounting for TST, is warranted to better understand how sleep may influence self-expectations of military performance.

Support (if any): Support for this study came from the Military Operational Medicine Research Program of the United States Army Medical search and Development Command.

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FOOD CONSUMPTION AND MEAL TIMING IN HOSPITAL NURSES WITH SHIFT WORK: A PRELIMINARY STUDY

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Introduction: One of the important nonphotic zeitgebers is food consumption. The timing of food consumption in relation to melatonin onset has been reported to be associated with fat proportion and BMI. Irregular meal timing along with irregular sleep schedules due to shift work would increase the metabolism problem as well as influencing sleep problems. The aim of the study is to evaluate the meal timing and food consumption in shift workers.

Methods: The nurses with 3-rapid rotating shifts were enrolled to keep food diaries for two weeks including all three shift schedules. They filled out a morningness-eveningness questionnaire. They wore actigraphy to monitor sleep-wake patterns with a daily sleep diary. The timing and the frequencies of meal/snack and caffeine consumption during each shift and day-off were reviewed. The calorie from each food was calculated depending on the nutritional information on the internet.

Results: 13 female nurses were screened and 6 finished the study. The mean age is 29.4±7.69 years and the mean body mass index was 20.2±1.1kg/m2. Average frequencies of meals are 2.59±0.49, 1.66±0.75, 1.93±0.41, 2.09±0.96 times per day, and average frequencies of snack consumption are 1.37±0.9, 1.07±0.74, 0.75±0.82, 0.96±0.79 times per day for the morning, evening, night, and the day off, respectively. Total calorie consumed are 1662.5±564.8, 1380.8 ± 940.3, 1596.8±838.1, 1505.8±706.9 kcals in the same order. Caffeine consumption was 0.29±0.46, 0.4±0.48, 0.72±0.65, 0.46±0.54 cups per day in the same order. One subject with morning type showed a relatively regular meal schedule throughout the shifts. The timing for main calorie consumption seemed to show delayed on evening and night shifts than morning shift although total calorie consumption was similar between each shift.

Conclusion: Although this is a preliminary study with a small number of subjects, it showed shift worker nurses have an inconsistent number of meals and calorie intake depending on their shifts. Caffeine consumption is very lower than expected. The subject with morning chronotype seemed to keep relatively regular meal timing throughout the shifts, suggesting chronotype influences meal timing in shift workers.

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OUTCOMES OF A SLEEP AND STRESS-FOCUSED EMPLOYEE WELLNESS PROGRAM

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Introduction: The Sleep More, Stress Less Program (SMSL) is a University of Alabama (UA) employee wellness program designed to help participants implement health behavior changes to improve sleep quality and stress management. Workplace wellness programs offer a win-win for the employee and employer through improved health and reduced absenteeism. However, many programs fail to show effectiveness on health and workplace metrics, even with an increase in targeted health behaviors. This may be due—at least in part—to employee

self-selection and data collection limitations. The SMSL program addresses these challenges by recruiting employees experiencing sleep and stress issues and using a rigorous assessment approach that records data on behavior changes, process goals, intermediate mechanisms, and health outcomes. We present findings from the SMSL program evaluation conducted Fall 2020.

Methods: The SMSL program is delivered online with both synchronous and asynchronous content (videos and exercises). The content combines evidence-based interventions for sleep and stress with the science of behavioral motivation. All adult (19–99 years) UA employees were eligible and recruitment occurred through the WellBama website and employee emails. Employees are encouraged to select programs that match their health issues. Participants complete an online pre-program assessment and track their sleep and stress for one week. Next, participants complete the SMSL educational program over the next three weeks. In the fifth week, participants track their sleep and stress and complete the online post-program assessment.

Results: 60 of the initial 85 participants completed all assessments (70.5%). Participants were primarily Female (79%) and Caucasian (77%) or Black (15%), and aged 24–68 (m=44) years. Moderate improvements were reported in total sleep time, sleep maintenance, and time to return to sleep after awakening. Similar improvements were observed in stress scores. Qualitative evaluation of participant behavior goals revealed a focus on sleep scheduling, stimulus reduction, and relaxation.

Conclusion: Employee wellness program evaluation is often affected by selection and measurement bias. The SMSL program targeted individuals experiencing stress and/or sleep problems and measured multiple outcomes to identify benefits over the 5-week program. Other wellness programs would benefit from this approach in order to capture true program outcomes.

Support (if any): N/A

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CAN A BRIEF SLEEP EDUCATION TRAINING IMPROVE SLEEP QUALITY AMONG SHIPBOARD SAILORS?

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Introduction: Sleep disturbance is pervasive among active duty military service members (ADSM) and has serious adverse effects on performance and health. Interventions designed to improve sleep in operational settings are critical to maintain the health and readiness of this at-risk population. The objective of this study is to evaluate a novel sleep education program developed for ADSM.

Methods: Participants were U.S. Sailors (N=150; 82.7% male, 35.3% <25 years old) assigned to either an intervention (44.7%) or control (55.3%) condition. Intervention participants attended the Circadian, Light, and Sleep Skills program for military personnel ("CLASS-M"). The 30-minute education program was designed to teach ADSM how to maximize sleep quality in operational environments. All participants completed a questionnaire at both baseline and 2 months post-intervention assessing demographics, sleep quality (Pittsburgh Sleep Quality Index; PSQI), sleep-related behaviors, knowledge and motivation. During the follow-up period, participants went underway for 2–8 weeks.

Results: At baseline, scores were comparable for the PSQI (Control: 8.58±0.35 vs. Intervention: 8.58±0.38), sleep behaviors (12.26±0.35 vs. 11.32±0.38; Range: 0–17), sleep-related knowledge (0.48±0.21 vs. 0.50±0.24; Range: 0–1), and sleep motivation (4.12±0.35 vs. 4.07±0.34; Range: 0–5). A significant group x time interaction indicating benefits for the intervention group were observed on PSQI ($F(1,139) = 7.99$, $p=0.005$), knowledge ($F(1,139) = 36.54$, $p<0.001$), and behaviors ($F(1,139) = 4.75$, $p=0.03$), but not motivation ($p>.05$). Main effects of group were observed ($p<0.05$) on PSQI and sleep knowledge only.

Conclusion: Study results indicate that participation in a brief, educational program prior to deploying may improve ADSM's sleep quality. Future research is needed to explore mechanisms of intervention effect, and to determine best practices for disseminating such programs force-wide.

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ASSOCIATIONS BETWEEN SLEEP REGULARITY AND BODY MASS INDEX: FINDINGS FROM A PROSPECTIVE STUDY OF FIRST-YEAR COLLEGE STUDENTS

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Introduction: College students often experience irregular sleep timing, short sleep duration, and weight gain. Using data from a large, prospective study on sleep in first-year college students, we examined whether students' sleep regularity index (SRI; Phillips et al., 2017) was associated with body mass index (BMI) and BMI change (ΔBMI) during the first nine weeks of their college semester.

Methods: Analyses included data from 583 students (mean age = 18.7± 0.5 years; 59% Female; 48% non-White) who had their height and weight assessed at the start of classes (T1) and end (T2) of nine weeks. ΔBMI was calculated as the difference between T2 and T1, with a positive value indicating an increase in BMI. Throughout the semester, participants completed on-line daily sleep diaries that included bedtime, wake-time, sleep onset latency, and wake after sleep onset for the previous major sleep episode and daytime naps. Based on this data, total sleep time (TST) was calculated as time spent asleep between bedtime and wake-time, and SRI was calculated by comparing participants' sleep/wake states across adjacent 24-hour periods. Average SRI reflects participants' sleep regularity (0 (random) to 100 (perfect regularity)) across the study. Data were analyzed with hierarchical linear regressions that controlled for sex and average TST.

Results: Average SRI was 74.1±8.7 (range 25.7–91.6). Average BMI at T1 was 22.0±3.5; 6% of participants were underweight (BMI less than 18.5), 6% overweight (≥25 and <30) and 3% obese (≥30). Greater BMI at T1 was correlated with less ΔBMI by T2 ($r=-.16$, $p<.001$). On average, participants gained 1.8±2.4kg (range: -7.2–11.4); 6% of participants lost ≥2kg, 39% gained 2-5kg, 8% gained more than 5kg. Average TST was not significantly correlated with BMI or ΔBMI. Lower SRI was associated with greater BMI at T1 (B= -.06 [95% CI: -.09– -.02], p=.001) but less ΔBMI (B= .01 [.002–.018], p=.018).

Conclusion: We found that lower sleep-wake regularity associated with greater baseline BMI but less BMI increase during the initial transition to college. Given that the majority of our participants were normal weight young adults, our findings may indicate that sleep regularity associates with healthy growth in this population.

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SLEEP OBTAINED BY CABIN CREWMEMBERS DURING A LONG-HAUL FLIGHT

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Introduction: Sleep loss and circadian disruption pose a significant risk in safety-sensitive occupations. In aviation, many studies have demonstrated how inflight rest locations influence alertness and performance among pilots, but few studies have evaluated cabin crew. The purpose of the present study was to evaluate sleep outcomes among cabin crewmembers sleeping in a bunk compared to a jump seat during one long-haul route.
Methods: Thirty-one (6 male) cabin crewmembers (age M = 30, SD = +/-13) flew the same long-haul route (outbound and return) with a flight duration of 10:41 (± 0:14) hours. Participants were randomly assigned to fly on an aircraft with a bunk or a jump seat for their sleep opportunity. Participants wore an Actiwatch (Phillips-Respironics Spectrum) throughout the entire study and completed a sleep diary at bedtime and upon waking. During flight they completed a nap diary entering the start time of the inflight sleep (if any) and the duration.
Results: Sixty-five flights (32 outbound and 33 return) were included in the analyses. Seventy-seven percent of the flights had a bunk and 23% had a jump seat. Crewmembers obtained M = 146.46 (± 67.20) minutes of rest out of which they slept M = 125.33 (± 64.91) minutes in the bunk. While using the jump seat, crewmembers obtained M = 169.53 (± 133.30) minutes of rest out of which they slept M = 142.92 (± 149.72) minutes. When crewmembers slept in the bunk, sleep latency was shorter (M = 13.69 ± 12.64 minutes) and efficiency was better (M = 76.16 ± 16.09 %) compared to the jump seat (sleep onset: M = 16.77 ± 13.89 minutes; sleep efficiency: M = 60.64 ± 17.42 %).
Conclusion: We found that cabin crewmembers slept for longer time when they used the jump seat. They fell asleep faster and their sleep efficiency was better when using the bunk compared to the jump seat. Further research is needed to understand how sleep quality and subsequent performance are influenced by sleep opportunity in a bunk compared to a jump seat.
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ALCOHOL AND THE SLEEP OF ELITE ATHLETES

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Introduction: Extensive evidence indicates that alcohol adversely affects athletic performance, increases the chance of injury, impairs aerobic metabolism, and has detrimental psychological influence. Alcohol consumption was also shown to be significant in young adults, with many elite athletes reporting alcohol intake. Sleep is essential to musculoskeletal recovery, acquisition of new skills, and emotional regulation in athletes. As insufficient sleep has detrimental effects on athletic performances and increases the risk of injury, we aimed to analyze the relation between alcohol consumption and sleep parameters among elite athletes.
Methods: We studied 9,164 nights recorded with the Boost application by 66 adult elite athletes from various sports during October 2019-December 2020. In addition to perceived and measured sleep parameters, nightly data included the previous day reported alcohol consumption and the number of training sessions. For each athlete, the average nightly mean heart rate (HR) in nights with reported alcohol consumption (AY) and without (AN) was calculated, as were the bedtime and the number of training sessions.
Results: In nights with reported alcohol, mean HR was higher (AY: 56.1±7.8 BPM, mean±SD, AN: 52.9±7.3 BPM, $p<.05$), while bedtime was later (AY: 23:16±70 minutes, AN: 22:52±55 minutes, $p<.05$) and fewer training sessions were reported in the following day (AY: 0.88±0.59 sessions, AN: 1.1±0.59 sessions, $p<.05$). No correlation was found between mean HR and bedtime in nights without alcohol consumption (r=0.3). 24% of Saturday night recordings included alcohol consumption reports, with 16% of Friday nights and 12–13% for each of the remaining weeknights.
Conclusion: Adult elite athletes report consuming alcohol, especially during weekends when the probability for a training session the following day is lower. Our data support the well documented physiological effect of alcohol via elevated mean HR values throughout the night. Athletes and coaches should be educated about the impacts of alcohol and insufficient sleep on wellbeing and performance.
Support (if any):

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ATHLETE SLEEP AND MENTAL HEALTH: DIFFERENCES BY GENDER, RACE, AND ETHNICITY

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Introduction: Sleep is important for athletic and academic performance, injury risk and recovery, and physical and mental health. However, athletes commonly have poor and insufficient sleep, which may be worsened by their inflexible schedules, stress, traveling, and timing of competition. To date, little is known about the relationship between sleep problems and risk for mental health problems in college student athletes. Almost nothing is known about gender, racial and ethnic sleep disparities in this group. The current study aimed to examine the cross-sectional relationships between sleep disorder symptoms and mental health symptoms, further examining differences by gender, race, and ethnicity.
Methods: Student athletes (N = 1033) from four universities within the Pacific Athletic Conference (PAC-12) were surveyed using previously-validated mental health questionnaires. Since few individuals self-identified as Asian, American Indian/Alaskan Native, Native Hawaiian/Pacific Islander, or "Other," the race variable was recoded into three groups: White, Black, and Other Underrepresented groups. Gender, race, and ethnicity differences on Athlete Sleep Screening Questionnaire (ASSQ) total scores were examined using a three separate MANOVAs. Next, sleep-disorder symptoms were classified as clinically relevant (n=174) or not (n=733) based on established cutoff values on the ASSQ. Gender and sleep disorder differences on mental health total scores were examined using a MANOVA.
Results: Women athletes reported significantly worse sleep disorder symptoms as a whole. In addition, Black athletes had worse sleep disorder symptoms. There was a trend for women with sleep problems to have higher PC-PTSD scores than women without sleep problems. In addition, athletes in the Other Underrepresented race group with sleep problems also had greater depression, PTSD, and psychotic symptom severity than White or Black student athletes. There was also a trend for Hispanic athletes with sleep disorder symptoms to have greater ADHD symptom severity.

Conclusion: To further examine individual differences in specific components of sleep symptoms, sleep duration, insomnia symptoms, medication, quality will be reported in the poster presentation. Future studies are needed to understand whether frequency and chronicity of athletic and external stressors, explain elevations in sleep and other psychiatrics symptoms in student athletes.

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COMORBIDITIES AMONG MEDICALLY DIAGNOSED INSOMNIA PATIENTS: A MARKETSCAN DATABASE STUDY

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Introduction: A large proportion of patients with insomnia frequently suffer from comorbid medical conditions. Literature on the relationship between insomnia and associated comorbidities is severely limited due to challenges of generalizability, focus on a specific comorbidity and concerns of information biases. We conducted a comprehensive secondary database analysis to describe comorbidities among medically diagnosed insomnia patients.
Methods: All patients in the MarketScan database in 2018 with a full year of enrollment were included. Insomnia patients were identified using ICD-10-CM diagnosis codes (at least 2 outpatient claims or 1 inpatient claim of insomnia in 2018), along with their comorbidities recorded in that year. The frequencies of comorbidities among patients with insomnia were estimated. For comorbidities with prevalence > 1%, we further grouped them when appropriate to reduce the number of comorbidities.
Results: Among 20,209,292 enrollees, 259,035 (1.3%) had insomnia in 2018. Patients with insomnia had a median of 2 (IQR: 1–3) insomnia claims. The mean age of these insomnia patients was 49.3 years (std: 15.7), most of them were female (62.5%). About 172 comorbidities with >1% were found in this patient population, and 35 comorbidities had a frequency greater than 10%. The common comorbidities among these insomnia patients included 1): common physical disorders among middle aged and older adults: hyperlipidemia (39%), hypertension (39%), skin diseases (37%), back pain 35%; 2):common mental health disorders such as anxiety disorder (41%), depression (28%); and 3): other diseases such as GERD and thyroid diseases also had high frequencies among insomnia patients (18% and 18.7%, respectively).
Conclusion: Using claims data, we provided a quantitative assessment of comorbidities among patients with medically diagnosed insomnia. These results could help clinicians become aware of the most frequently occurring comorbidities and assist in integrating management of the insomnia.
Support (if any):

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SLEEP-WAKE SURVIVAL DYNAMICS IN PEOPLE WITH INSOMNIA

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Introduction: Assessing objective measures of sleep fragmentation could yield important features reflecting impaired sleep quality in people with insomnia. Survival analysis allows the specific examination of the stability of NREM sleep, REM sleep and wake. The objective of this study was to assess the differences between survival dynamics of NREM sleep, REM sleep and wake between people with insomnia and healthy controls.
Methods: We analyzed polysomnography recordings from 88 people with insomnia and 92 healthy controls. For each participant, survival dynamics of REM sleep, NREM sleep and wake were represented using Weibull distributions. We used lasso penalized linear regression to analyze the difference between participant groups with respect to the Weibull scale and shape parameters, while correcting for age, sex, total sleep time and relevant interaction effects. Because comparisons were done for scale and shape parameters of REM sleep, NREM sleep and wake, a Bonferroni correction was applied, resulting in an alpha value of 0.05/6 = 0.0083.
Results: Significant effects of group were found for the NREM scale parameter (unstandardized model coefficient B=-0.79, t=-3.0, p=0.0035), and for the scale and shape parameters of wake (scale parameter B=7.6, t=2.8, p=0.0065; shape parameter B=0.20, t=2.9, p=0.0048). Results indicated that people with insomnia had less stable NREM sleep and more stable wake after sleep onset compared to healthy controls. Additionally, the altered distribution of wake segment lengths indicated an increased difficulty to fall asleep after longer awakenings in the insomnia group. However, these differences were mainly observed in younger participants. Significant effects of group for the survival parameters of REM sleep were not found.
Conclusion: As illustrated by our results, survival analysis can be very useful for disentangling different types of sleep fragmentation in people with insomnia. For instance, the current findings suggest that people with insomnia have an increased fragmentation of NREM sleep, but not necessarily of REM sleep. Additional research into the underlying mechanisms of NREM sleep fragmentation could possibly lead to a better understanding of impaired sleep quality in people with insomnia, and consequently to improved treatment.
Support (if any):

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AREA DEPRIVATION AND SLEEP HEALTH AMONG WHITE, BLACK, AND HISPANIC/LATINA WOMEN

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Introduction: Although neighborhood environments have been shown to affect sleep health, few studies have directly measured multiple indicators of both neighborhood deprivation and sleep while considering modification by race/ethnicity.
Methods: Among 49,833 eligible U.S. women enrolled in the Sister Study from 2003 to 2009, we investigated associations between neighborhood deprivation (e.g., percentage of residents unemployed, household crowding) and multiple sleep dimensions. Participants' addresses were linked to U.S. census block group level Area Deprivation Index rankings (range: 1–100) for the year 2000, and participant rankings were divided into quintiles where the highest quintile represented the highest deprivation level. Participants self-reported habitual sleep duration, sleep debt, frequent napping, and insomnia symptoms. Adjusting for sociodemographic and clinical characteristics, we used Poisson regression with robust variance to estimate prevalence ratios (PRs) and 95% confidence intervals (CIs) for sleep dimensions among participants within quintiles (Qs) 2–5 vs. Q1. Interaction terms were used to assess modification by race/ethnicity.
Results: Mean age ± standard deviation was 55 ± 9 years. Women with higher neighborhood deprivation were more likely to self-identify as a racial/ethnic minority and had higher unadjusted prevalence of poor sleep dimensions. After adjustment, higher ADI was positively associated with very short sleep (≤5 hours), and race/ethnicity was a modifier (e.g., race-stratified results for Q5 vs. Q1:PRWhite=1.31 [95% CI: 1.14–1.51], PRBlack=0.91 [0.71–1.18], PRHispanic/Latina= 1.17 [0.68–2.04], p-interaction <0.05). Although race/ethnicity did not modify remaining associations, women with higher neighborhood deprivation also had a higher prevalence of sleep debt, frequent napping, and insomnia symptoms. When compared to White women with the lowest neighborhood deprivation, Black women across all deprivation

levels and Hispanic/Latina women in Q2-Q5 were substantially more likely to report each poor sleep dimension (PR range: 1.21 to 5.01).
Conclusion: A multidimensional measure of neighborhood deprivation was associated with poor sleep and sleep disparities among a diverse cohort of U.S. women.
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VALIDATION OF THE INSOMNIA SEVERITY INDEX SHORT-FORM FOR IDENTIFYING INSOMNIA DISORDER IN YOUNG ADULT CANCER SURVIVORS

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Introduction: Insomnia is a common and impairing late effect experienced by many young adult cancer survivors (YACS). Although routine evaluation of sleep disorders in cancer survivors is recommended, lack of consensus on appropriate screening measures contributes to under-identification and under-treatment of these disorders in YACS. As screening measures are ideally as brief as possible while maintaining validity, we sought to validate the recently published three-item Insomnia Severity Index Short-Form (ISI-SF) in YACS.
Methods: 250 YACS completed the ISI and the Structured Clinical Interview for the DSM-5 (SCID-5). The ISI-SF was created by summing three ISI items: distress (item #6), interference (item #7), and satisfaction (item #4). In receiver operating characteristic (ROC) analyses, area under the curve (AUC) was calculated to compare discrimination on the ISI-SF to two criteria: the full-scale ISI using a cutoff of ≥8 recently validated in this sample, and the SCID-5 insomnia module. Consistent with previous research, we specified a priori that a cut-off score on the ISI-SF with sensitivity ≥.85 and specificity ≥.75 would be acceptable.
Results: The ISI-SF had excellent discrimination when compared to the full-scale ISI (AUC = .97) and a cut-off score of ≥4 met criteria with a sensitivity of 97% and specificity of 86%. The ISI-SF had good discrimination when compared to the SCID-5 (AUC = .88), but none of the cut-off scores met a priori criteria for sensitivity and specificity. A cut-off score of ≥4 came closest with a sensitivity of 94% and specificity of 70%.
Conclusion: Although the ISI-SF did not meet sensitivity and specificity criteria for a stand-alone screening measure when compared to a diagnostic interview, it demonstrated utility as the first step in a two-step screening procedure. Specifically, the high sensitivity of the ≥4 ISI-F cut-off score is well-suited to accurately screening out YACS who do not need insomnia services; as a second screen, the SCID-5 insomnia module could be administered only to those elevated on the ISI-SF in order to identify false positives cases before making referrals for insomnia specialists.
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EFFECT OF ACCUMULATED UNHEALTHY BEHAVIORS ON INSOMNIAÂ€•LIFESTYLE-RELATED DISEASE DIFFERENCES IN A JAPANESE COMMUNITY POPULATION.

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Introduction: Some studies reported that health behaviors and lifestyles are related to sleep disorder; obesity, drinking, smoking and lack of physical exercise are risk factors for insomnia. However, it's unclear the association between accumulated unhealthy behaviors and insomnia in consideration of lifestyle-related diseases. Therefore, this study was to examine the effect of accumulated unhealthy behaviors on insomnia in a Japanese community population.
Methods: The subjects included 1,1002 participants aged 35–74 years. Sleep quality was assessed by the Athens Insomnia Scale. Unhealthy behaviors were classified into smoking, drinking, no habit of exercising, obesity, and skipping breakfast. We examined the impact of unhealthy behaviors accumulation, which was stratified into three categories, i.e., 0-1,2-3,4 or more, on insomnia. The association between accumulated unhealthy behaviors and insomnia was estimated by logistic regression analysis. Further analysis after stratification by lifestyle-related diseases was also performed.
Results: The overall prevalence of insomnia was 14.6% for men and19.3% for women. Men with unhealthy behaviors were more likely to have insomnia after adjusting for potential confounders, compared with the least unhealthy groups (trend p=0.017). Women with 4 or more unhealthy behavior factors were more likely to have the suspected insomnia, compared with the lowest groups (ORs 1.176 95% CI 1.079–1.282). Then, we analyzed to stratify by lifestyle-related disease. Insomnia has an association with unhealthy behaviors among men with the absence of diabetes (trend p=0.015) and dyslipidemia (trend p=0.032). Women without hypertension were more likely to have the suspected insomnia, compared with the lowest groups (ORs 1.215 95% CI 1.102–1.340), but the odd for those with the hypertension was 1.031(95%CI 0.855–1.243).
Conclusion: Accumulated unhealthy behaviors were associated with increased rates of insomnia in the Japanese community population. According to stratification by lifestyle-related disease, men showed the associations by the presence or absence of diabetes. Women showed the associations by the absence of hypertension. These associations were nearly similar regardless of the presence or absence of lifestyle-related disease.
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SUBJECTIVE SLEEP AND NEO FIVE FACTOR PERSONALITY DOMAINS IN INDIVIDUALS WITH PRIMARY INSOMNIA COMPARED TO GOOD SLEEPER CONTROLS

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Introduction: Insomnia is a common sleep disorder in adults. Primary Insomnia (PI) can be specified in cases where the insomnia symptoms cannot be overtly attributed to medical, psychiatric, or environmental reasons. Although the underlying predisposing causes of insomnia are unclear, one possible contributing factor may be personality traits. To date no consensus on the relationship between insomnia and personality has been determined, although many studies have found a general association with neuroticism. To better explore these associations, this study compared NEO Five Factor Model (FFM) personality traits with measures of subjective sleep in PIs and Good Sleeper (GS) controls.
Methods: Nine PI and nine GS matched for age, sex, and education were studied. Each participant was administered the Insomnia Severity

Index (ISI), Pittsburgh Sleep Quality Index (PSQI), and NEO FFM. Participants also completed a sleep diary for 1-week. ANOVAs compared PI vs GS on ISI, PSQI, NEO FFM, and 7-day averaged data from the sleep diary. Lastly, sleep variables were collapsed across groups and Pearson correlations were run to explore the relationship between sleep and personality.

Results: PIs (4M/5F, age=39.6+/-10.1, education=16.0+/-1.7) and GSs (4M/5F, age=38.6+/-7, education=15.1+/-1.5) showed significant differences in ISI (p<.001) and PSQI (p<.001) total scores. Additionally, the groups differed on diary measures of total sleep (p=.001), sleep efficiency (SE: p<.001), sleep latency (p=.005), and wake after sleep onset (p<.001). On the NEO FFM only the Agreeableness domain was found to differentiate the two groups (p=.004). Pearson correlations found significant negative relationships for Agreeableness with ISI (r= -.625/p=.006), PSQI (r= -.611/p=.007), and a significant positive relationship with SE from the sleep diary (r=.602/p=.008).

Conclusion: In a small but well-matched study of PI and GS, significant differences in Agreeableness on the NEO FFM were observed. Lower levels of agreeableness were associated with poorer sleep on the ISI and PSQI, and lower SE on the sleep diaries. Unlike other published reports this study did not find a relationship between insomnia and neuroticism, which may reflect the use of a well-screened Primary Insomnia sample with limited comorbidities. Future research should determine if other insomnia subtypes (e.g., psychophysiological, paradoxical insomnia) are associated with different personality profiles.

Support (if any):

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COMPARISONS OF CLINICAL AND POLYSOMNOGRAPHIC CHARACTERISTICS BETWEEN NEGATIVE AND POSITIVE SLEEP STATE MISPERCEPTION IN INSOMNIA

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Introduction: Most of insomnia patients tend to underestimate their sleep duration and quality. In current study, we classified insomnia patients into negative sleep state misperception (NSSM) group and positive sleep state misperception (PSSM) group according to difference between subjective and objective sleep duration. We compared clinical and polysomnographic characteristics between two groups.

Methods: Objective sleep measures using nocturnal polysomnography (nPSG) and subjective measures including Pittsburgh Sleep Quality Index (PSQI), Beck Depression Inventory (BDI) and subjective questionnaire at the morning after overnight nPSG of 150 insomnia patients were reviewed. The questionnaire included subjective total sleep time (subjective TST), subjective sleep latency (subjective SL). Additionally, TST/SL discrepancy was calculated by subtracting objective variables of nPSG from the morning subjective questionnaire. We calculated misperception index (MI) using the following method; MI=(objective TST-subjective TST)/objective TST. According to MI value, insomnia patients were classified into NSSM (MI>0, n=115), and PSSM (MI<0, n=35) groups.

Results: There were no significant differences in nPSG parameters, except N3 sleep (%); the PSSM group had significantly higher N3 sleep than NSSM group (p=0.002). On the subjective measures, the NSSM group had significantly higher PSQI score (p<0.001), longer subjective SL (p=0.001) and higher SL discrepancy (p=0.001). In the NSSM group, MI showed positive correlations with N1 sleep proportion (r=0.250, p=0.011), PSQI (r=0.250, p=0.011), BDI (r=0.211, p=0.032), subjective SL (r=0.441, p<0.001) and SL discrepancy (r=0.453, p<0.001). Meanwhile, there were no significant correlations of MI with subjective measures in PSSM group. In the multiple regression analysis, MI was related with SL discrepancy and BDI (R2=0.216, p=0.004) in NSSM group. For belonging the PSSM group, associated factors were N3 sleep (OR=1.075, p=0.001), PSQI (OR=0.813, p=0.002) and SL discrepancy (OR=0.956, p<0.001) on binary logistic regression analysis.

Conclusion: In the NSSM group, MI was related with high SL discrepancy and depressive mood. High N3 sleep, low PSQI score, and low SL discrepancy were associated factors in the PSSM group. Perception of sleep should be properly evaluated and managed, since they vary with different characteristics of sleep state misperception.

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IS DAYTIME NAPPING A RISK FACTOR FOR PERSISTENT INSOMNIA SYMPTOMS?

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Introduction: Napping, episodes of short daytime sleep separated from the main sleep period, can compensate for the detrimental effects of inadequate night-time sleep or, as 'siestas', may form an integral part of personal sleep-wake schedules. Napping may also precipitate or perpetuate insomnia symptoms through the erosion of homeostatic sleep pressure at night. Using longitudinal data, these analyses were designed to evaluate links between daytime napping styles and the incidence of persistent insomnia symptoms, in a sample of middle aged and older adult good sleepers at baseline.

Methods: 567 participants (65% female; >35 years old) were sub-sampled from the NITES cohort (Perlis et al, 2019). All were self-rated good sleepers, reporting typical sleep latencies (5 nights/week) and WASO durations of = 1 nap/baseline period) or habitual (>= 2 naps/week). 'Persistent insomnia symptoms' cases reported sleep initiation and/or maintenance complaints on >= 3 nights/week for at least two consecutive weeks. Relationships between nap categories and the incidence of persistent insomnia symptoms arising in months 4–12 of the study were assessed in logistic regression models adjusted for age, gender, employment status and depression. Risk is expressed as the odds ratio (OR) with 95% confidence interval (CI).

Results: Prevalence rates for ever/habitual napping were 57% and 10%. Unemployed status and aged 50+ significantly increased habitual nap probability. The 1-year incidence of persistent insomnia symptoms was 5.6%. In logistic regression models, 'ever' napping was associated with an almost 3-fold increase in the risk of developing persistent insomnia symptoms (OR=2.994; 95% CI 1.244–6.969; p=.014). When the logistic regression model was rerun with habitual napping, the risk attenuated substantially (OR = 1.4, 95% CI .592–3.163; p=.463).

Conclusion: These results suggest that napping patterns serve as a marker for insomnia symptom development, with haphazard non-habitual napping patterns associated with significantly greater risk.

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NATURALISTIC CHARACTERIZATION OF SLEEP IN CHRONIC INSOMNIA USING A NON-CONTACT SLEEP MEASUREMENT DEVICE

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Introduction: Individuals with insomnia report poor sleep quality and non-restorative sleep, and often exhibit irregular sleep patterns over days and weeks. First night effects and logistical challenges make it difficult to measure these sleep characteristics in the laboratory. Also, sensitivity to sleep disruption from obtrusive measurement devices confounds sleep measurements in people with insomnia in their naturalistic setting. Non-contact sleep measurement devices have the potential to address these issues and enable ecologically valid, longitudinal characterization of sleep in individuals with insomnia. Here we use a non-contact device – the SleepScore Max (SleepScore Labs) – to assess the sleep of individuals with chronic insomnia, compared to healthy sleeper controls, in their home setting.
Methods: As part of a larger study, 13 individuals with chronic insomnia (ages 25-60y, 7 males) and 8 healthy sleeper controls (ages 21-46y, 6 females) participated in an at-home sleep monitoring study. Enrollment criteria included an age range of 18-65y and, for the insomnia group, ICSD-3 criteria for chronic insomnia with no other clinically relevant illness. Participants used the non-contact sleep measurement device to record their sleep periods each night for 8 weeks. Sleep measurements were analyzed for group differences in both means (characterizing sleep overall) and within-subject standard deviations (characterizing sleep variability across nights), using mixed-effects regression controlling for systematic between-subject differences.
Results: Based on the non-contact sleep measurements, individuals with chronic insomnia exhibited greater variability in bedtime, time in bed, total sleep time, sleep latency, total wake time across time in bed, wakefulness after sleep onset, sleep interruptions, and estimated light sleep, compared to healthy sleeper controls (all $F>5.7$, $P<0.05$). No significant differences were found for group averages and for variability in estimated deep and REM sleep.
Conclusion: In this group of individuals with chronic insomnia, a non-contact device used to characterize sleep naturalistically captured enhanced variability across nights in multiple aspects of sleep stereotypical of sleep disturbances in chronic insomnia, differentiating the sample statistically significantly from healthy sleeper controls.
Support (if any): NIH grant KL2TR002317; research devices provided by SleepScore Labs.

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STRESS-INDUCED PHYSIOLOGICAL PROFILES AMONG DIFFERENT PHENOTYPE INSOMNIACS

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Introduction: Stress reactivity and autonomic nervous system (ANS) dysregulation have been suggested to be the pathophysiology of insomnia. Based on the finding PSG-measured short sleep duration was associated with higher morbidity of metabolic and cardiovascular disease. Vgontzas and Fernandez-Mandoza (2013) proposed that objective sleep duration is a biomarker for insomnia phenotypes. The phenotype with short objective sleep duration is associated with increased stress-related physiological hyperarousal. The present study aims to test this hypothesis by comparing the stress-induced cardiovascular reactivity between insomnia patients with short and long objective sleep durations.
Methods: 27 insomnia patients (age mean 34.48 ±12.87, Male: Female= 6:21) without comorbidity of psychiatric, medical or sleep disorders participated in this study. They went through one night of 8-hour PSG recording and were divided into two groups by their total sleep time with a cutoff of 6 hours. Nine participants were in short sleep duration group and 18 in longer sleep duration group. Psychophysiological reactivity profile, as recorded with EKG, skin conductance (SC), body temperature (BT), blood volume pulse (BVP), respiration rate (RR), was measured under three conditions: baseline resting state, arithmetic word problems solving, and recovery resting state.
Results: Both groups showed similar stress physiological response with increased heart rate (HR) and SC, nearly equivalent BT and BVP, and decreased RR when solving arithmetic problems, and opposite reaction during recovery resting state. Mann-Whitney U test comparing the changes from baseline resting state on all the psychophysiological measures between two phenotypes of insomnia showed no significant differences: stress-induced heart-rate ($U=106$, $p=.119$.) recovery heart-rate ($U=44$, $p=.095$), stress-induced skin conductance ($U=104.5$, $p=.132$),recovery skin conductance ($U=51.5$, $p=.198$), stress-induced body temperature ($U=79$, $p=.897$),recovery body temperature ($U=60.5$, $p=.418$), stress-induced blood volume pulse amplitude ($U=77$, $p=1.0$), and recovery blood volume pulse amplitude ($U=69$, $p=.735$), stress-induced respiration rate ($U=76$, $p=.696$), and recovery respiration rate ($U=85$, $p=.658$).
Conclusion: Our results indicate that the insomnia phenotypes with short and long objective sleep duration are not different in their stress-induced physiological responses. Future studies are needed to confirm these results and to explore other mechanisms for the increased metabolic and cardiovascular disease risk in insomnia patients with short objective sleep duration.
Support (if any):

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COMPARISON OF PSYCHOLOGICAL AND PHYSIOLOGICAL FEATURES BETWEEN INSOMNIA PATIENTS WITH SHORT AND NORMAL OBJECTIVE SLEEP DURATION

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Introduction: Objective sleep duration has been suggested to be a novel biomarker in the phenotyping of insomnia (Vgontzas & Fernandez-Mendoza, 2013). It was hypothesized that insomnia phenotype with PSG-defined short sleep duration (< 6 hours) is associated with physiological hyperarousal, while the phenotype with normal sleep duration (≥ 6 hours), is associated with anxious-ruminative psychological profile and poor resources for coping with stress. The aim of this study was to assess whether these two insomnia phenotypes differ in terms of self-reported psychological and physiological features.
Methods: A total 45 (mean age=36.6, female=76%) insomnia patients underwent a polysomnographic evaluation, completed several self-rating scales (include ISI, BAI, BDI, FIRST, DBAS, and PSAS),

and were split into two groups base on their objective sleep duration (cut-off 6 hours).
Results: When compared to the short sleep group using independent sample t-test, the normal sleep group showed a significant higher mean score on FIRST (t= -2.13; p< .05). The short sleep group showed non-significant trends to have higher mean scores on BDI and BAI. The scores on the other scales showed no significant differences between the two groups. The FIRST score correlated positively with the score of DBAS (r= 0.32; p< .05) and the total (r= 0.36; p< .05) and cognitive-subscale scores (r= 0.41; p< .01) on PSAS. The BAI score correlated positively with the score of the total (r= 0.53; p< .001) and somatic subscale (r= 0.59; p< .001) on PSAS.
Conclusion: These results support the hypotheses that the normal sleep phenotype tends to be more vulnerable to the impact of stress, especially on sleep, due to pre-sleep cognitive hyperarousal. Since the BAI scale contains more items regarding physiological symptoms of anxiety disorders, the tendency of higher BAI score in short sleep group may indicate that the short sleep phenotype has higher physiological arousal, which supports the phenotyping model proposed by Vgontzas and Fernandez-Mandoza.
Support (if any):

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DEVELOPMENTAL TRAJECTORIES OF INSOMNIA AND RISK OF INTERNALIZING DISORDERS IN YOUNG ADULTHOOD

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Introduction: Internalizing disorders (ID) are the most common form of psychopathology and a large proportion of individuals experience their first onset after the age of 18. Childhood insomnia symptoms, i.e., difficulties initiating or maintaining sleep (DIMS), have been shown to be associated with ID. However, little is known about the developmental trajectories of insomnia symptoms and their associated risk of ID as the child transitions into adulthood. The present study examined the risk of ID in young adulthood associated with the longitudinal trajectories of insomnia symptoms across three developmental stages.
Methods: The Penn State Child Cohort is a population-based sample of 700 children (Mdn=9y), who were followed-up 8 years later as adolescents (N=421, Mdn=16y) and 15 years later as young adults (N=492, Mdn=24y). Insomnia symptoms were defined as parent-reported (childhood) or self-reported (adolescence and young adulthood) moderate-to-severe DIMS. The developmental trajectories of insomnia symptoms across the three time-points were identified as never, remitted, waxing-and-waning, persistent and incident. The presence of ID was defined as a self-report of a diagnosis or treatment for mood and/or anxiety disorders. Cox regression models were adjusted for sex, race/ethnicity, age and childhood/adolescent history of ID or psychoactive medication use.
Results: A persistent developmental trajectory was associated with a 2.8-fold increased risk of adult ID (HR=2.83, 95%CI=1.79–4.49) and an incident trajectory with a 1.9-fold risk (HR=1.88, 95%CI=1.10–3.20), while a waxing-and-waning trajectory was marginally associated with adult ID (HR=1.70, 95%CI=0.99–2.91). A remitting trajectory was not associated with an increased risk of adult ID (HR=0.92, 95%CI=0.38–2.24).
Conclusion: This 15-year longitudinal study with three developmental stages shows that childhood-onset insomnia symptoms that persist across the life-course are strong determinants of ID in young adulthood, independent of past diagnosis or medication use. In contrast, childhood insomnia symptoms that remit in the transition to adolescence do not confer increased risk of ID in young adulthood. Given that insomnia symptoms may precipitate and/or maintain ID, these data further reinforce the need for early sleep interventions to prevent mental health disorders.
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INSOMNIA IN OLDER HIV PATIENTS: A SYSTEMATIC REVIEW

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Introduction: Insomnia is a common sleep disorder in elderly. Although the HIV-positive population have a similar life expectancy when compared to the general population, some factors may interact with immunity conditions and therefore contribute to a worse prognosis. Little is known however, about the frequency of insomnia in older HIV-positive patients. OBJECTIVE: To systematic review the prevalence of insomnia in older HIV-positive patients.
Methods: Systematic Review. Several databases were consulted (MEDLINE-PubMed, Embase, Cochrane Library, CINAHL, Web of Science, Scopus, SciELO, LILACS, and VHL) and manual searches were performed. The terms used for the search were related to prevalence, HIV, insomnia, and advanced age. The inclusion criteria were: cross-sectional, cohort, and longitudinal studies. The accepted data were in patients with the previous diagnosis of HIV in advanced age, those over 50 years; studies that report the frequency of insomnia or insomnia symptoms (accepted symptoms: difficulty in starting sleep, difficulty in maintaining sleep, multiple awakenings during sleep and early awakening). The criteria for exclusion were: clinical trials, animal studies, letters, abstracts, conference proceedings, studies with other sleep scales that did not include insomnia.
Results: There were 2805 publications found in the database and a further 10 articles were included manually. Of this total, four were included in this review, resulting in a total of 2,227 participants. The prevalence of insomnia in HIV-positive patients over 50 years varied from 12.5% to 76.5%.
Conclusion: The frequency of insomnia was higher in the profile of the population studied than in the general population. This should be clinically relevant in order to adequately treat and impact on the prognosis of those patient.
Support (if any):

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HIGH PREVALENCE OF SLEEP DIFFICULTIES AND LOW RATE OF SEEKING PROFESSIONAL HELP IN POLISH POPULATION

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Introduction: The number of people suffering from sleep disorders is on the rise. Insomnia is a complex issue with an impact on numerous aspects on everyday functioning. At the same time it is highly dependent on an individual's lifestyle and untreated episodic sleep issues may lead to chronić insomnia. The aim of the present study was to

assess complaints regarding sleep difficulties among men and women in Poland, as well as their severity and whether it leads to seeking treatment.
Methods: Data was gathered as a part of an online-based nationwide campaign on insomnia, which included a survey assessing sleep quality. The survey was developed for the purpose of this study. Statistical analysis included Chi-Square and Mann-Whitney tests as well as Spearman's correlations.
Results: Responses were obtained from 3807 individuals – 2616 (68.7%) women and 1191 (31.3%) men. Sleep issues with the highest prevalence were sleep maintenance difficulties reported by 62.8% of the respondents, snoring among 61.2%, sleep initiation difficulties (sleep latency of over 30 minutes) among 55.6%, daytime sleepiness among 49.5%, and symptoms of Restless Leg Syndrome among 45.1%. Out of the participants who reported at least one sleep issue, the rate of having been to a professional consultation was 20.8% - 22.8% among women and 16.4% among men.
Conclusion: Even though the prevalence of different sleep troubles was very high, it did not correspond to the rate of seeking professional help. The vast majority of both men and women who experienced sleep difficulties had never consulted with a specialist regarding their sleep quality. There is a great need for psychoeducation of the general public on sleep as a vital component of health and on benefits of professional help.
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CHARACTERISTICS ASSOCIATED WITH NAPPING AMONG PREGNANT WOMEN WITH INSOMNIA

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Introduction: Napping is common in pregnant women; however, characteristics associated with napping in pregnant women with insomnia have not been studied.
Methods: We used baseline data from a randomized controlled trial of insomnia treatment during pregnancy for this cross-sectional analysis (n=159). Women self-reported sociodemographic characteristics (age, race/ethnicity, education, income, employment), pregnancy-related characteristics (parity, trimester), sleep-related characteristics (7-day sleep diary including total napping time per day, Insomnia Severity Index), and depression symptoms (Edinburgh Postnatal Depression Scale). Women were categorized as non-nappers (0 days with napping), infrequent nappers (1–3 days with napping), and frequent nappers (≥4 days with napping). Characteristics were compared across napping categories using descriptive statistics and multinomial logistic regression.
Results: Eighteen percent of women were frequent nappers, 53% were infrequent nappers, and 30% were non-nappers. Average time spent napping on days with naps was 67 minutes (SD=35). In unadjusted analyses, frequent nappers were more likely to have a high school diploma or less (36% vs 19%), be unemployed (57% vs 41%), and be nulliparous (21% vs 13%) than non-nappers. Infrequent nappers were more likely to have a 4-year college degree (32% vs 11%), have a household income $100k or more (58% vs 45%), be working full time (51% vs 39%), and be nulliparous (26% vs 13%) than non-nappers. Age, race/ethnicity, trimester, sleep-related characteristics, and depression symptoms were similar across napping categories. In analyses adjusted for education and trimester, being unemployed (OR=3.6; 95% CI: 0.8, 15.4), working part time (OR=2.3; 95% CI: 0.5, 11.2), and nulliparity (OR=2.4; 95% CI: 0.4, 14.6) were most strongly associated with frequent napping (though confidence intervals were wide) but were not associated with infrequent napping. Sleep-related characteristics were not associated with frequent or infrequent napping in adjusted analyses.
Conclusion: Among pregnant women with insomnia, frequent napping was associated with characteristics that suggest greater feasibility of napping (not working, working part time, pregnant with first child), but was not associated with nocturnal sleep parameters or insomnia severity. Given napping can reduce homeostatic sleep drive at bedtime, it should be addressed during insomnia treatment in pregnant women, particularly among women with greater opportunity to nap.
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ADVERSE CHILDHOOD EXPERIENCE AND SLEEP QUALITY IN ADULTHOOD

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Introduction: Poor sleep quality, a risk factor for many negative health outcomes, may result from physical or emotional disturbance including chronic stress. Adverse childhood experiences (ACEs) have been linked with chronic stress, and may therefore be associated with poor sleep quality in adulthood. This study examines the longitudinal association between specific ACEs and the number of ACEs and sleep quality in adulthood.
Methods: Using data from the National Longitudinal Study of Adolescent to Adult Health, we examined the association between ACEs and trouble falling asleep or staying asleep (rarely or never, sometimes, frequently) in waves 1 (age 12–18), 4 (age 24–32), and 5 (age 33–43). We examined ten ACEs (physical, sexual, or emotional abuse; neglect; parental death, incarceration, alcoholism, divorce or separation; foster home placement; poverty; and exposure to community violence) and the number of ACEs (0, 1, 2–3, 4+), using weighted logistic regression to calculate odds ratios and confidence intervals for each of the ACEs and ACE score and each of the outcomes after adjusting for relevant confounders.
Results: The analysis included 12,768 participants, 75.3% of whom experienced at least one ACE, including 14.7% who experienced 4 or more. Physical and emotional abuse were associated with frequent sleep complaints at waves 1, 4, and 5. Sexual abuse, neglect and community violence were associated with frequent complaints in two waves, while parental alcoholism, parental incarceration, and foster home placement were associated with frequent complaints in one wave. The number of ACEs experienced showed a dose-response association with frequent sleep complaints in wave 1 ([1 ACE: aOR=2.12 (1.16, 3.9), 2–3 ACEs: aOR=2.86 (1.70, 4.82), 4+ ACEs: aOR=4.17 (2.33, 7.48)], wave 4 [1 ACE: aOR=1.02 (0.77, 1.36); 2–3 ACEs: aOR= 1.66 (1.30, 2.10); 4+ ACEs: aOR=2.68 (1.99, 3.61) and in wave 5 [1 ACE: aOR=1.22 (0.93, 1.60)), 2–3 ACEs: aOR=1.42 (1.11, 1.81), 4+ ACEs: aOR=1.88 (1.40, 2.53)]
Conclusion: Certain adverse childhood experiences such as physical, sexual, and emotional abuse and neglect have a lasting impact on sleep quality in adulthood, highlighting the need to mitigate their impact to prevent negative health outcomes associated with poor sleep quality
Support (if any):

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NON-REM EEG SPECTRAL POWER AT BASELINE AND AFTER TOTAL SLEEP DEPRIVATION IN INDIVIDUALS WITH SLEEP-ONSET INSOMNIA

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Introduction: The baseline non-REM sleep EEG of individuals with insomnia has been found to display increased spectral power at frequencies >14Hz, which may reflect hyperarousal. There is some evidence in this population of reduced slow wave activity after total sleep deprivation (TSD), potentially indicating altered sleep homeostasis. We investigated non-REM sleep EEG spectra at baseline and after TSD in individuals with sleep-onset insomnia.
Methods: 10 individuals with sleep-onset insomnia and 5 healthy controls (ages 22-40y, 11 females) completed a 5-day laboratory study with an adaptation night, baseline night, assignment to 38h TSD (n=5 insomnia, n=5 control) or equivalent non-TSD control (n=5 insomnia), and recovery night. Sleep periods were 10h (22:00-08:00) with digital polysomnography (250Hz; Nihon Kohden). Following artifact rejection, 5s subepochs of the non-REM (stages N2, N3) sleep EEG (C3-M2 derivation) in baseline and recovery nights were subjected to spectral analysis. Spectra (0.2Hz bins) were averaged over subepochs in 30s epochs. Repeated-measures ANOVA compared baseline spectra between insomnia and controls, and baseline-recovery difference spectra between TSD insomnia, non-TSD insomnia, and TSD controls.
Results: Average non-REM sleep amount was 5.9 at baseline, increasing by 1.1h after TSD, with no differences between groups ($p \geq 0.20$). At baseline, the insomnia group showed increased power in theta/alpha (~4–12Hz), reaching significance in the lower spindle range, compared to controls ($p < 0.05$). As anticipated, no differences emerged between baseline and recovery nights in the non-TSD insomnia group. However, the TSD insomnia group showed increased delta (~1–3Hz) and theta/alpha (~6–10Hz) power ($p < 0.05$) during recovery. Healthy controls showed expected power increases in delta and lower spindle range, and decreases in upper spindle range (~14–15Hz), after TSD ($p < 0.05$).
Conclusion: Compared to healthy controls, individuals with sleep-onset insomnia showed increased non-REM sleep EEG power in the theta/alpha bands and low spindle frequency range, with further significant increases in theta/alpha in addition to delta power following TSD, despite small sample size. The increase in delta power following TSD was equivalent to that in healthy controls, suggesting no sleep homeostasis abnormality. Whether the elevated theta/alpha power may be related to hyperarousal is unclear.
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ASSOCIATIONS BETWEEN INSOMNIA AND HEALTH CORRELATES IN NURSES

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Introduction: Insomnia, shiftwork (i.e., circadian rhythm disruptions) and insufficient sleep are common among nurses and healthcare workers. Each of these sleep problems can contribute to physical (e.g., inflammation, musculoskeletal pain, cardiovascular disease and heart rate variability, indigestion, and menstrual cycle irregularity) and mental (e.g., depression, anxiety, suicidality) health problems as well as daytime fatigue and sleepiness among nurses and may contribute to burnout and job change.
Methods: Participants (N=458) were nurses recruited for a parent study, "Sleep and Vaccine Response in Nurses (SAV-RN)" (Taylor & Kelly: R01AI128359-01). Most identified as female (90.5%), White/Caucasian (77.2%), and non-Hispanic (88.6%) with an average age of 39.03 (SD = 11.07). Participants completed baseline measures online via Qualtrics survey. The Sleep Condition Indicator (SCI; Espie et al., 2014) was used to identify a probable diagnosis of insomnia (score of ≤16 = Insomnia; endorsement of each of the primary DSM-5 criteria on the measure). In addition, a checklist of current major health conditions (high blood pressure, sleep apnea, GI issues, HIV/AIDS, cancer, etc.) was also completed. A Chi square test of Independence was conducted using SPSS to determine if insomnia detected by the SCI was associated with reported health conditions.
Results: At baseline, 25.4% of nurses had a probable insomnia diagnosis. Insomnia was associated with a greater likelihood of diagnosed sleep apnea, cancer (all types), high blood pressure, chronic pain, gastrointestinal problems, an autoimmune disease, and/or an endocrine problem at Month 11 of the study (all ps <.05). Data cleaning is ongoing, but similar analyses will be presented examining shift work sleep disorder and insufficient sleep (i.e., average < 6hrs per night) as individual and simultaneous predictors of physical and mental health at baseline and change from baseline to Month 11 (if available).
Conclusion: These results help to identify associations between insomnia and health conditions in nurses and may contribute to future research that supports evidence-based intervention and prevention strategies for this population. While evidence-based interventions for sleep disturbances and insomnia exist (CBT-I), accessibility and feasibility of scaling such interventions to reach the nursing community at large remains challenging.
Support (if any):

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36 MONTH SURVEILLANCE CONFIRMS FAVORABLE SAFETY PROFILE OF A NOVEL CONTINUOUS RELEASE AND ABSORPTION MELATONIN DELIVERY SYSTEM

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Introduction: The cumulative long-term effects of sleep loss have been associated with a wide range of damaging health consequences. There is a medical need for novel, non-pharmacological sleep aid alternatives. The ideal sleep solution would allow sleep to occur with normal sleep architecture and without causing dependence or daytime somnolence. Melatonin with its soporific effects and benign safety profile has been shown to be an effective sleep aid to decrease sleep onset latency, increase total sleep time and improve overall sleep quality. The novel, well tolerated CRA-melatonin, with the unique design of its delivery system, was shown in a randomized, crossover, pharmacokinetic (PK) study versus the leading marketed melatonin to achieve quick uptake and then continuous release and absorption for up to 7 hours. The REMfresh Safety Update at 36 months (REMSU36), a real world safety surveillance analysis was conducted to confirm the previously observed safety profile of CRA-melatonin.
Methods: An independent call center with pharmacovigilance-trained health care personnel, was retained to receive and record customer questions, product issues and adverse events (AEs). The data collection was conducted from March 9, 2017 to March 9, 2020. An estimated 981,735 adults used CRA-melatonin during the surveillance period.

Results: There were no serious AEs reported. Eighty-one (81) non-serious AEs were recorded, resulting in a 0.008% event reporting rate. The two most frequent AEs were headaches (7) and dizziness (5), which are also known comorbidities of chronic sleeplessness.
Conclusion: CRA-melatonin with its extended 7 hour PK profile may be an effective, well tolerated baseline therapy to improve sleep in adults These results, in a real world setting, support the previous reports of safety and tolerability of melatonin, as well as observed in the CRA-melatonin PK study.
Support (if any):

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EVALUATION OF DOSE TRANSITION FROM ZOLPIDEM TO LEMBOREXANT ACROSS 14 WEEKS: RESULTS FROM A MULTICENTER OPEN-LABEL PILOT STUDY

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Introduction: E2006-A001-312 (Study 312; NCT04009577) was an open-label pilot study that examined pre-specified dosing paradigms for transitioning patients from zolpidem (ZOL: immediate [IR] or extended-release [ER]) to the dual orexin receptor antagonist lemborexant (LEM; 5mg [LEM5] or 10mg [LEM10]).
Methods: Study 312 included a 3-week Screening Period (subjects continued ZOL), 2-week Titration Period (TITR), 12-week Extension Period (EXT), and 4-week Follow-up Period. Adults with insomnia who were intermittent (3–4 nights/week) or frequent (≥5 nights/week) ZOL-IR or ZOL-ER users participated. Intermittent ZOL users and subjects with one week each of intermittent and frequent ZOL usage were assigned to Cohort-1 and began TITR with LEM5. Frequent ZOL users were assigned to Cohort-2 and randomized 1:1 to LEM5 or LEM10. Subjects who successfully transitioned to LEM had the option to enter EXT. During TITR and EXT, subjects could change LEM dose (only once during TITR). The primary endpoint was the proportion of subjects who transitioned to LEM at the end of TITR. Treatment-emergent adverse events (TEAEs) were assessed based on dose at time of TEAE.
Results: Fifty-three subjects enrolled (Cohort-1, n=10; Cohort-2, n=43). Of these, 43/53 (81.1%) transitioned to LEM at the end of TITR; all 43 (100.0%) entered EXT wherein 41/43 subjects received treatment. Three of these subjects discontinued treatment during EXT, so that 38/41 (92.7%) subjects entered EXT, received treatment and completed EXT. At the end of EXT, 25/41 (61.0%) subjects were receiving LEM10 and 16/41 (39.0%) were receiving LEM5. Based on modal dose (most frequent dose taken during TITR and EXT combined) groups, median time to first dose change was 14.5 days and 36.0 days for LEM5 and LEM10, respectively. The majority of TEAEs were mild/moderate in severity. Across the study (TITR and EXT), more TEAEs occurred with LEM10 than LEM5; the most common TEAEs were somnolence (n=4) and abnormal dreams (n=4).
Conclusion: Study results support the view that patients can successfully transition directly from ZOL to LEM. LEM was generally well tolerated; the safety profile was consistent with that observed in Phase 3 clinical development.
Support (if any): Eisai Inc.

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EFFECT OF LEMBOREXANT VERSUS PLACEBO AND ZOLPIDEM ON REM SLEEP BY QUARTER NIGHT INTERVALS IN OLDER ADULTS WITH INSOMNIA DISORDER

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Introduction: Effects of the dual orexin receptor antagonist lemborexant (LEM) on sleep architecture in adults ≥55y with insomnia disorder were assessed in Study E2006-G000-304 (Study 304; SUNRISE-1; NCT02783729). These post hoc analyses of Study 304 examined the acute effect of LEM on REM pressure (REM latency [REM-L] and REM by quarter of the night [QoN]).
Methods: This study was a 1mo, randomized, double-blind, placebo- and active-controlled (zolpidem tartrate extended-release 6.25mg [ZOL]) study of LEM (5mg, LEM5; 10mg, LEM10). Subjects received placebo (n=208), ZOL (n=263), LEM5 (n=266), or LEM10 (n=269). Two nights of PSGs were recorded at baseline, first 2 (N1/2), and last 2 (N29/30) treatment nights.
Results: Baseline REM-L (minutes) was similar across treatments (98.4–101.4). Significant decreases from baseline in REM-L were observed for LEM5 (−42.6 [53.9]) and LEM10 (−49.6[52.9]) vs placebo (−6.9[54.5]) and ZOL (0.2[54.2]) on N1/2 (all P<0.0001). No difference was observed for ZOL vs placebo. Baseline REM (minutes) for each QoN was similar across treatments. In Q1, mean(SD) REM (minutes) on N1/2 was 16.5(9.7), 19.7(10.5), 10.3(8.2), and 8.5(7.6) for LEM5, LEM10, placebo, and ZOL, respectively. The difference was significant for LEM5 and LEM10 vs placebo and ZOL (all P<0.0001), and ZOL vs placebo (P<0.05). In Q2, mean(SD) REM on N1/2 was 19.2(9.4), 21.6(10.0), 17.9(8.9), and 17.2(9.3) for LEM5, LEM10, placebo, and ZOL, respectively. The difference was significant for LEM10 vs placebo (P<0.0001) and for LEM5 and LEM10 vs ZOL (P<0.01, P<0.0001, respectively). No difference was observed for ZOL vs placebo. In Q3, mean(SD) REM on N1/2 was 23.3(10.3), 25.9(9.7), 20.8(9.4), and 22.8(9.9) for LEM5, LEM10, placebo, and ZOL, respectively. The difference was significant for LEM5, LEM10, and ZOL vs placebo (P<0.01, P<0.0001, P<0.05, respectively) and LEM10 vs ZOL (P<0.001). In Q4, mean (SD) REM on N1/2 was 23.8(9.4), 26.1(11.0), 21.6(10.9), and 22.5(10.1) for LEM5, LEM10, placebo, and ZOL, respectively. The differences were significant for LEM5 and LEM10 vs placebo (P<0.05, P<0.0001, respectively), and for LEM10 vs ZOL (P<0.0001). Generally, similar findings were noted at N29/30; these data will be reported.
Conclusion: LEM, but not ZOL, acutely increases REM pressure as evidenced by REM latency and REM duration per quarter.
Support (if any): Eisai Inc.

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A MULTICENTER OPEN-LABEL PILOT STUDY EVALUATING NEXT-DOSE TRANSITION FROM ZOLPIDEM TO LEMBOREXANT: ANALYSIS OF FEMALE SUBGROUP

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Introduction: Dosing paradigms for transitioning patients to lemborexant (LEM) from zolpidem (ZOL: immediate [IR] or extended-release [ER]) were examined in E2006-A001-312 (Study 312; NCT04009577), an open-label pilot study. Given insomnia prevalence in women, post hoc analyses in female subjects were conducted.
Methods: Study 312 included: 3-week Screening Period (subjects continued ZOL); 2-week Titration Period (TITR); 12-week Extension Period (EXT); 4-week Follow-up. Adults with insomnia taking ZOL-IR or ZOL-ER intermittently (3–4 nights/week) or frequently (≥5 nights/week) were enrolled. Subjects with intermittent, or one week each of intermittent and frequent ZOL use, were assigned to Cohort-1 and

started TITR with LEM 5mg (LEM5). Frequent ZOL users (Cohort-2) were randomized 1:1 to LEM5 (Cohort-2A) or LEM 10mg (LEM10; Cohort-2B). Subjects who transitioned to LEM could opt into EXT. Subjects could change LEM dose during TITR (only once) and during EXT. The primary endpoint was the proportion of subjects who transitioned to LEM at end of TITR. Treatment-emergent adverse events (TEAEs) were assessed by dose at time of TEAE.

Results: Overall, 35 subjects were female and 29/35 (82.9%) transitioned to LEM. In Cohort-1, 7 subjects began TITR; all transitioned to LEM (5 subjects ended TITR on LEM5; 2 ended on LEM10). In Cohort-2A, 14 subjects began TITR with LEM5; 12/14 (85.7%) transitioned (6 subjects each ended TITR on LEM5 or LEM10). In Cohort-2B, 14 subjects began TITR with LEM10; 10/14 (71.4%) transitioned to LEM (3 subjects ended TITR on LEM5 and 7 on LEM10). All 29 transitioned subjects opted into EXT, and 27/29 (93.1%) completed the study. Based on modal dose (most frequent dose taken during TITR and EXT combined) groups, median time to first dose change during EXT was 14.5 and 17.0 days for LEM5 and LEM10, respectively. Overall, most TEAEs were mild/moderate in severity. Across TITR and EXT, more TEAEs occurred with LEM10 than with LEM5; the most common TEAEs were somnolence (n=3) and abnormal dreams (n=3).

Conclusion: Most female subjects successfully transitioned from intermittent or frequent ZOL-IR/ZOL-ER use to LEM and completed the study. LEM was generally well tolerated. The safety profile was consistent with that observed in Phase 3 studies.

Support (if any): Eisai Inc.

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HOW MUCH IMPROVEMENT IN THE INSOMNIA SEVERITY INDEX IS ASSOCIATED WITH A POSITIVE IMPACT OF A PATIENT'S INSOMNIA MEDICATION?

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Introduction: In Phase 3 Study 304 (SUNRISE-1; NCT02783729) and Study 303 (SUNRISE-2; NCT02952820), lemborexant (LEM) provided significant benefit versus placebo on sleep diary-based sleep onset/maintenance outcomes over 1mo and 6mo, respectively, in subjects with insomnia disorder. Both studies included the Insomnia Severity Index (ISI) and the Patient Global Impression–Insomnia version (PGI-I). On the PGI-I scale, subjects assess positive, neutral or negative treatment impact on falling asleep, overall benefit on sleep, and total sleep time. Using an anchor-based approach, ratings were compared with mean changes in ISI scores from baseline to evaluate what would be considered a responder definition on the ISI.

Methods: Study 304 was a 1mo, randomized, double-blind, placebo- and active-controlled, parallel-group study in female (age ≥55y) and male (age ≥65y) subjects (n=1006); subjects received placebo, LEM 5mg, LEM 10mg, or zolpidem tartrate extended-release. Study 303 was a 12mo, randomized, double-blind study in subjects age ≥18y (n=950). Subjects received placebo, LEM 5mg, or LEM 10mg for 6mo. Data from both studies were pooled for the first month of treatment across all treatment groups. A modified ISI total score (ISI-ts) was used based on a confirmatory factor analysis that showed no incremental value to including Question 5 (How NOTICEABLE to others do you think your sleep problem is in terms of impairing the quality of your life?).

Results: The 'Overall Sleep' PGI-I item demonstrated that mean [SD] changes from baseline in ISI-ts decreased more in association with self-reported positive effects (−8.15 [4.98]) than for neutral (−3.59 [3.37]) or negative effects (−1.67 [2.91]) at Day 31/Month 1. For PGI-I Item 'Time to Fall Asleep,' mean (SD) changes from baseline in ISI-ts were −7.49 (5.10) for positive, −4.54 (4.13) for neutral, and −2.94 (4.04) for negative effects at Day 31/Month 1. For PGI-I Item 'Total Sleep Time' mean (SD) changes from baseline in ISI-ts were −8.15 (5.04) for positive, −3.74 (3.23) for neutral, and −2.40 (3.49) for negative effects at Day 31/Month 1.

Conclusion: Results of this anchor-based approach using the PGI-I suggest that the responder definition for ISI-ts, using the modified ISI, should be approximately −8 points.

Support (if any): Eisai Inc.

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LONG-TERM PERCEPTION OF MEDICATION EFFECTIVENESS IN SUBJECTS RECEIVING LEMBOREXANT FOR UP TO 12 MONTHS

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Introduction: The Patient Global Impression–Insomnia version (PGI-I) is a self-report instrument used to evaluate a patient's perception of the effects of their insomnia medication on their sleep relative to starting treatment. The PGI-I includes 3 items related to medication effects (helped/worsened sleep; decreased/increased time to fall asleep; and increased/decreased total sleep; responses include: 1=positive, 2=neutral, 3=negative) and 1 item related to perceived appropriateness of study medication strength (responses include: 1=too strong, 2=just right, 3=too weak). In Study E2006-G000-303 (Study 303; SUNRISE-2; NCT02952820), significantly greater percentages of subjects reported a positive impact of the dual orexin receptor antagonist lemborexant (LEM) versus placebo (PBO) at 1, 3, and 6mo for each of the PGI-I items related to medication effects. PGI-I results at 9 and 12mo are presented here for subjects that received continuous treatment with LEM for up to 12mo.

Methods: Study 303 was a 12-mo, randomized, double-blind, PBO-controlled (first 6mo [Period 1]), phase 3 study. Subjects were aged ≥18y with insomnia disorder. During Period 1, subjects received PBO (n=318) or LEM (5mg, [LEM5], n=316; 10mg, [LEM10], n=315). During Period 2 (second 6mo), LEM subjects continued their assigned dose while PBO subjects were rerandomized to LEM5 or LEM10 (reported separately). Subjects were also administered the PGI-I at months 9 and 12.

Results: At 9 and 12mo, the majority of LEM5 (9mo, n=241; 12mo, n=205) and LEM10 (9mo, n=211; 12mo, n=192) subjects reported that their study medication "helped" sleep at night (9mo: LEM5=73.4%; LEM10=76.3%; 12mo: LEM5=74.6%; LEM10=77.6%), reduced time to fall asleep (9mo: LEM5=79.3%, LEM10=78.2%; 12mo: LEM5=76.6%, LEM10=80.2%), and increased total sleep time (9mo: LEM5=62.2%, LEM10=73.0%; 12mo: LEM5=62.4%; LEM10=65.1%). Also, at both 9 and 12mo, the majority of subjects in the LEM5 and LEM10 groups, responded that treatment strength was "just right" (9mo: LEM5=60.6%, LEM10=62.1%; 12mo: LEM5=63.4%; LEM10=60.4%). LEM was well tolerated. Most adverse events were mild or moderate.

Conclusion: The majority of subjects receiving LEM5 or LEM10 reported a positive medication effect at both 9 and 12mo, sustaining similar positive effects for LEM achieved earlier, during the first 6mo of treatment in Study 303.

Support (if any): Eisai Inc.

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IMPROVING MATERNAL SLEEP VIA COGNITIVE BEHAVIORAL INTERVENTION: A RANDOMISED CONTROLLED TRIAL FROM PREGNANCY TO 2 YEARS POSTPARTUM

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Introduction: Maternal sleep disturbance is common during pregnancy and postpartum periods. This study evaluated the feasibility and efficacy of a scalable cognitive behavioural therapy (CBT) sleep intervention tailored for these periods.

Methods: This is a two-arm, parallel-group, single-blind, superiority randomised controlled trial. Nulliparous women without major medical/psychiatric conditions were randomised 1:1 to CBT or active control of equal frequency/duration. All participants received a 1-hr telephone session and automated multimedia emails from the 3rd trimester until 6 months postpartum. Outcomes were assessed with validated instruments at gestation weeks 30 (baseline) and 35 (pregnancy endpoint), and postpartum months 1.5, 3, 6 (postpartum endpoint), 12, and 24.

Results: 163 eligible participants (age M +/- SD = 33.35 +/- 3.42) were randomised. The CBT intervention was well accepted, with no reported adverse effect. Intention-to-treat analyses showed that compared to active control, receiving CBT was associated with lower insomnia severity and sleep disturbance (two primary outcomes), and lower sleep-related impairment at the pregnancy endpoint (p-values ≤ .001), as well as at 24 months postpartum (p ranges .012-.052). Group differences across the first postpartum year were nonsignificant. Women with elevated insomnia symptoms at baseline benefitted substantially more from CBT (vs control), including having significantly lower insomnia symptoms throughout the first postpartum year. Group differences in symptoms of depression or anxiety were nonsignificant.

Conclusion: A scalable CBT sleep intervention is efficacious in buffering against sleep disturbance during pregnancy, with long-term benefits to maternal sleep, especially for women with sleep complaints during pregnancy. The intervention holds promise for implementation into routine perinatal care.

Support (if any): Data collection was supported by Rob Pierce Grant-in-Aid and Helen Bearpark Scholarship from Australasian Sleep Association, Strategic Grant Scheme from Monash University, and the Royal Women's Hospital Foundation. Intervention materials were adapted from those developed via a National Institute of Health R01 grant (NR013662). Bei (APP1140299) and Wiley (APP1178487) are supported by National Health and Medical Research Council Fellowships, and Pinnington, Quin, Shen by Australian Postgraduate Awards by Department of Education and Training. The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

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ACUTE EFFECTS OF SELTOREXANT, A SELECTIVE OREXIN-2 ANTAGONIST (JNJ- 42847922), ON DRIVING AFTER BEDTIME ADMINISTRATION

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Introduction: Seltorexant (JNJ-42847922), a potent and selective antagonist of the human orexin-2 receptor, is being developed for the treatment of major depressive disorder. Seltorexant also has sleep-promoting properties. Investigating the effects of sleep-promoting medications on driving is important because some of these agents (e.g. GABAA receptor agonists) may be associated with increased risk of motor vehicle accidents. We evaluated the effect of seltorexant on driving after forced awakening at night, using a validated driving simulator.

Methods: This double-blind, placebo and active-controlled, randomized, 3-way cross-over study was conducted in 18 male and 18 female healthy subjects. All subjects received seltorexant 40 mg, zolpidem 10 mg, or placebo 15 minutes before bedtime. Eighteen subjects were awakened at 2- and 6-hours post-dose, and the other 18 at 4- and 8-hours post-dose. At those timepoints, pharmacokinetics, objective (standard deviation of the lateral position [SDLP]) and subjective effects (using Perceived Driving Quality and Effort Scales) on driving ability, postural stability and subjective sleepiness were assessed.

Results: For seltorexant, the SDLP difference from placebo (95% confidence interval) at 2-, 4-, 6- and 8-hours post-dose was 3.9 cm (1.26, 6.60), 0.9 cm (-1.08, 2.92), 1.1 cm (-0.42, 2.63), and 0.6 cm (-2.75, 1.55), respectively vs. 9.6 cm (6.97, 12.38), 6.6 cm (3.53, 9.60), 4.7 cm (1.46, 7.85), and 1.3cm (-1.16, 3.80), respectively for zolpidem. The difference from placebo was significant at 2-hours after taking seltorexant, while the difference from placebo was significant at 2, 4 and 6-hours after zolpidem. Subjective driving quality was decreased for both drugs at all time points and driving effort was increased up to 4-hours post-dose for both medications. Subjective sleepiness showed a significant increase compared to placebo 2- and 4-hours after administration of either drug. Postural stability was decreased up to 2-hours after administration of seltorexant, and up to 4-hours after administration of zolpidem.

Conclusion: Compared to zolpidem, objective effects on driving performance were more transient after seltorexant administration and largely normalized by 4–6 hours post-dose.

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CBT-I HAS SUSTAINED EFFECTS ON INSOMNIA VERSUS HEART-FAILURE SELF-MANAGEMENT EDUCATION AMONG ADULTS WITH CHRONIC HEART FAILURE

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Introduction: Insomnia is common among adults with chronic heart failure (HF), often not explained by sleep apnea (SA), and associated with daytime symptoms and poor daytime function. The purpose of this randomized controlled trial was to evaluate the sustained effects of cognitive behavioral therapy for insomnia (CBT-I) on insomnia severity and sleep characteristics over 6 months among adults with stable chronic HF.

Methods: We included adults with HF who had at least mild insomnia [Insomnia Severity Index (ISI) > 8] and no more than mild SA or SA treated with continuous positive airway pressure. We randomized in groups to 8 weeks of group CBT-I (Healthy Sleep: HS) [4 group sessions + calls on alternate weeks] or attention control (Healthy Hearts: HH) [HF self-management education + brief sleep hygiene] in

the same format. We administered the ISI, the Pittsburgh Sleep Quality Index (PSQI), the Dysfunctional Beliefs & Attitudes about Sleep Scale (DBAS), and the Sleep Disturbance Questionnaire (SDQ) at baseline (T0), 2 weeks after treatment ended (T1) and at 6 months (T2). Statistical analysis included descriptive statistics and mixed effects models with random intercepts and slopes.
Results: The sample include 175 participants (HS: N = 91; 62 + 13 years; 58% Male; 15% Black; 68% NY Heart Class II-III) (HH: N = 84; 64 + 12.5 years; 56% Male; 17% Black; 70% NY Heart Class II-III). There was no significant difference at baseline in demographic characteristics or the mean ISI [HS: 15.3 (4.5); HH: 14.4 (4.5)], but a greater percentage in the HS group had clinical/moderate-severe insomnia (ISI > 15) (HS: 60.4% vs. HH: 47%). The CBT-I intervention (HS) was associated with significant improvement in insomnia severity (ISI: p = .001), sleep quality (PSQI: p = .002), and sleep-related cognitions (DBAS: p = .0006; SDQ: p = .0138), and a modest effect on self-reported sleep duration (46 vs. 20 mins, p = .054), but no effect on sleep efficiency. At 6 months, 12.9% of the HS group, compared with 24.9% of the HH group had clinical insomnia.
Conclusion: CBT-I has sustained effects on insomnia, sleep-quality, and sleep-related cognitions in people with HF.
Support (if any): R01NR01691 (NSR, PI)

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A BENEFIT-RISK ASSESSMENT OF DARIDOREXANT FOR THE TREATMENT OF INSOMNIA USING PATIENT PREFERENCE DATA FROM TWO PHASE 3 TRIALS

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Introduction: The efficacy and safety of daridorexant, a dual orexin receptor antagonist intended to treat insomnia, was demonstrated in two placebo-controlled phase III trials. Both pivotal trials included instruments for eliciting treatment preferences of enrolled patients, to interpret the trial findings from their perspective using a patient-centered benefit-risk assessment (pBRA).
Methods: Digital ethnographies and qualitative interviews with insomnia patients informed the design of a discrete choice experiment (DCE). The DCE was pre-tested in qualitative and quantitative pilots before inclusion in the trials. Within the DCE, patients were asked to make trade-offs between seven outcomes ("time to fall asleep," "total time asleep," "daytime functioning," "likelihood of daytime dizziness/grogginess," "likelihood of abnormal thoughts and behavioural changes," "likelihood of falls in the night," and "treatment withdrawal"). The preference data were analysed using a mixed logit (MXL) model that accounted for preference heterogeneity. Relative attribute importance (RAI) and maximum acceptable risk (MAR) of abnormal thoughts and behavioral changes were obtained from the MXL. A pBRA combined elicited preferences with collected clinical trial data to predict preferences for daridorexant over placebo. Sensitivity analysis accounted for uncertainty in both clinical outcomes and preferences.
Results: Patients valued all seven outcomes ($p < 0.05$), but considered improving daytime functioning (RAI = 33.7%) and avoiding treatment withdrawal (RAI = 27.5%) as most important. Patients were also willing to accept an additional 18.8% risk (p-value < 0.001) of abnormal thoughts and behavioral changes for an improvement in daytime functioning from difficulty functioning to restricted functioning. The pBRA suggested that both daridorexant 50 mg and 25 mg were significantly preferred (p-value < 0.001) over placebo, and 50 mg was significantly preferred (p-value < 0.001) over 25 mg, even after accounting for uncertainty in clinical outcomes and preferences.
Conclusion: All seven outcomes included in the DCE were valued by patients, but improving daytime functioning and avoiding severe treatment withdrawal was considered as most important. Daridorexant 50 mg and 25 mg were found to be significantly preferred over placebo, suggesting a positive benefit-risk balance of both doses. Overall, the preference data allowed for an innovative interpretation of the trial data from patients' perspective.
Support (if any):

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DARIDOREXANT IMPROVES TOTAL SLEEP TIME (TST) IN INSOMNIA PATIENTS WITHOUT ALTERING THE PROPORTION OF SLEEP STAGES

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Introduction: Daridorexant, a new dual orexin receptor antagonist, improved sleep parameters and daytime functioning in two pivotal Phase 3 trials in patients with insomnia (Trial-1, NCT03545191; Trial-2, NCT03575104); polysomnography data were collected at multiple timepoints from >1,800 patients. We report the effects of daridorexant on TST and sleep stages from both trials.
Methods: Eligible patients with insomnia (according to DSM-5) were randomized (1:1:1) in Trial-1 (N=930) to daridorexant 25mg, 50mg, or placebo and in Trial-2 (N=924) to daridorexant 10mg, 25mg, or placebo. Oral treatment was administered each night during a 3-month double-blind treatment period. Assessment of TST and sleep stages (non-rapid eye movement [NREM, N]1, N2, N3, REM), measured by polysomnography in sleep laboratory, was performed on two consecutive nights during single-blind placebo run-in (baseline) and Months 1 and 3 (M1 and M3) of double-blind treatment. Change from baseline in TST and sleep stages were exploratory endpoints in both trials. Data for M3 (mean ± standard deviation) are presented as change from baseline.
Results: Daridorexant dose-dependently increased TST(minutes) from baseline to M3, more than placebo, in Trial-1 (25mg, 55±56; 50mg, 61±53; placebo, 40±56) and Trial-2 (10mg, 37±57; 25mg, 50±53; placebo, 35±56). In both trials, sleep stage proportions were preserved from baseline to M3, with no relevant changes in any group. Baseline time spent in each sleep stage (% of TST) was consistent across groups in both trials (range across treatment groups in both trials: N1:11–13; N2:55–57; N3:11–14; REM:19–20). In Trial-1 (25mg/50mg/placebo), the change from baseline to M3 in % of TST spent in N1(-0.3±4.7/-0.2±5/0.1±5), N2(2±8/1±7/1±7), N3(-2±6/-2±6/-2±6), and REM(1±6/1±5/1±5) was low and numerically similar across treatments. In Trial-2, the change from baseline to M3 in % of TST spent in each sleep stage was consistent with Trial-1, with no effect of dose. Mean changes from baseline (% of TST) for each sleep stage appeared to be independent from increasing TST. Data for 25mg were consistent between trials.
Conclusion: Daridorexant at any dose, and each more than placebo, increased TST in a dose-dependent manner without affecting the proportion of all sleep stages in patients with insomnia.
Support (if any): Funded by Idorsia Pharmaceuticals Ltd.

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PRELIMINARY EFFICACY OF CBT-I FOR PSYCHOSIS IN A VETERAN SAMPLE

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Introduction: Sleep dysfunction is pervasive in people with psychosis. Insomnia worsens psychotic symptoms and functioning, though treating insomnia can improve functioning. Cognitive Behavioral Therapy for Insomnia (CBT-I) is an effective treatment, but there has been limited research on CBT-I in persons with psychosis. There is mounting evidence that sleep disturbances in people with psychiatric disorders do not improve with treatment of psychiatric illness. The present study 1) developed empirical guidelines for tailoring CBT-I to the needs of people with psychosis and insomnia; 2) conducted a preliminary efficacy study of CBT-I with these novel guidelines for psychosis; and 3) utilized objective and subjective insomnia and functional measures.
Methods: Novel psychosis guidelines were developed in response to illness-related, environmental, and practical challenges for engaging in traditional components of CBT-I, identified via a series of 25 qualitative interviews and an uncontrolled acceptability trial. A preliminary efficacy study of CBT-I with novel psychosis guidelines was conducted against an active treatment comparison group. Forty-seven Veterans with insomnia and co-occurring psychotic-spectrum disorder completed sleep measures, including the Insomnia Severity Index (ISI), at baseline, post-treatment, and 3-month follow-up.
Results: Psychosis guidelines for CBT-I included supporting integrated care (e.g., with case managers, prescribers, etc.), simplifying instructions on all treatment materials, reminder handouts, reality testing with sleep-related experiences, cognitive restructuring guidance for common sleep-related cognitions held by people with psychosis, techniques for use during psychotic experiences at bedtime. At post-treatment and follow-up, there was a large effect of CBT-I on ISI scores (d = 1.00, 1.18, respectively). Further, a clinically significant reduction in mean ISI score of participants was observed in the CBT-I condition (> 6), but not in the control condition. Participants in the CBT-I group reported reductions in daily functional impairment due to sleep problems (from 89% to 50%), while the control group reported a slight increase in functional impairment (from 86% to 88%).
Conclusion: CBT-I delivered with guidelines for psychosis should be further investigated with a larger randomized controlled trial over a longer time period of 6 months.
Support (if any): Time on this project was supported by the U.S. Department of Veterans Affairs, Rehabilitation Research and Development Service-1IK2RX001836, PI: Elizabeth A. Klingaman.

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SEMI-INDIVIDUALIZED ACUPUNCTURE FOR INSOMNIA DISORDER: A RANDOMIZED SHAM-CONTROLLED TRIAL

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Introduction: Acupuncture is an alternative treatment for improving sleep quality and the effectiveness is thought to be optimized with an individualized approach resembling real practice. However, existing evidence is limited by methodological shortcomings due to blinding issues, standardized measures, and diagnostic procedures. It was of the present study's interest to examine the efficacy and safety of semi-individualized acupuncture treatment on insomnia.
Methods: Adults with DSM-5 insomnia disorder (n = 140) were randomized with 1:1 allocation to a 4-week intervention traditional acupuncture (TA) or validated non-invasive sham acupuncture (SA). The selection of acupoints was semi-individualized by the acupuncturist. As the primary outcome, the sleep efficiency (SE) by sleep diary was assessed at baseline, 1-week posttreatment, and 5-week posttreatment. Other sleep parameters derived from sleep diary, the wrist-actigraphy-derived sleep parameters, insomnia symptom severity, anxiety, and depressive symptoms, as well as the health-related quality of life, were also evaluated.
Results: Although linear mixed-effect model revealed both groups did not attain significant difference in sleep-diary-derived SE and other outcome measures (all P > 0.05), TA promising effect on improving insomnia symptom (within-group effect size, d = 1.13 & 1.30 at 1-week & 5-week posttreatment respectively) and also a higher proportion of subjects achieved SE ≥ 85% compared with SA (55.6% versus 36.4% at week 9, P = 0.03). Besides, subjects in TA group reported significantly greater improvement in both the total sleep time (TST) derived from sleep diary and actigraph than those in the SA group at 1-week posttreatment (difference in mean changes from baseline: sleep diary = 22.0 min, p = 0.01; actigraphy =18.8 min, P = 0.02) but not 5-week posttreatment.
Conclusion: This study is the first to evaluate the effect of the TCM-theory-based individualized acupuncture on sleep using a sham-control design. A 4-week semi-individualized acupuncture is able to significantly increase total sleep time with few adverse events.
Support (if any): Research Grants Council of Hong Kong, Early Career Scheme (Project no.: 25101017)

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DARIDOREXANT IS SAFE AND IMPROVES BOTH SLEEP AND DAYTIME FUNCTIONING IN ELDERLY PATIENTS WITH INSOMNIA

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Introduction: Insomnia affects elderly more than younger adults, and comorbidities more prevalent in elderly populations can add to symptom burden and reduce therapeutic options. Drugs that improve insomnia symptoms with limited safety risks are needed to treat this patient group. We report elderly subgroup analyses from a Phase-3 registration trial with daridorexant.
Methods: In this multi-center, double-blind trial (NCT03545191), adult (18–64y) and elderly (≥65y) patients with insomnia were randomized (1:1:1) to receive oral daridorexant 25mg, 50mg or placebo every evening for 3 months. Month 3 endpoints were: change from baseline in polysomnography-measured wake-after-sleep-onset (WASO) and latency-to-persistent-sleep (LPS) (both primary endpoints), subjective total sleep time (sTST), and daytime functioning (Insomnia Daytime Symptoms and Impacts Questionnaire [IDSIQ] – sleepiness domain; with a lower score indicating improved daytime functioning).

Safety endpoints included treatment emergent adverse events (TEAE), AEs of special interest (AESI; symptoms related to excessive daytime sleepiness or complex sleep behavior, and suicidal ideation/self-injury) and withdrawal effects upon treatment cessation (assessed by the Benzodiazepine Withdrawal Symptom Questionnaire total score and relevant AEs).
Results: Of the 930 patients randomized, 364 (39.1%) were ≥65y: daridorexant 25mg (n=121), 50mg (n=121) and placebo (n=122). In this subgroup, at Month 3, the placebo-corrected least-square mean of change from baseline [95%CL] for daridorexant 25mg and 50mg were: WASO -17.0[-27.0,-7.0] and -19.6[-29.5,-9.7] mins; LPS -7.8[-15.2,-0.4] and -14.9[-22.3,-7.5] mins; sTST 18.7[4.1,33.2] and 30.6[16.1,45.2] mins; IDSIQ sleepiness domain -0.6[-2.2,0.9] and -2.6[-4.1,-1.0], all respectively. TEAEs were reported in 32.2%, 35.3%, and 31.1% of patients ≥65y in the 25mg, 50mg and placebo groups, respectively. Falls (n=1,1,4 for 25mg, 50mg, placebo, respectively) and dizziness (n=4,1,1), both of particular interest in elderly, were least frequent in the 50mg group. Compared to placebo, somnolence was as frequent for 50mg daridorexant (n=6,1,1) while fatigue was more frequent in both daridorexant groups (n=4,3,1); incidence did not appear dose-related. AESI, of mild intensity, were reported in 2 patients ≥65y (one in each daridorexant group). There was no evidence of withdrawal symptoms.
Conclusion: Daridorexant is efficacious in the elderly population for improvements in sleep and daytime functioning. No safety concerns in this vulnerable population were identified at either dose.
Support (if any): Funded by Idorsia Pharmaceuticals Ltd.

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ABSENCE OF WITHDRAWAL SYMPTOMS AND REBOUND INSOMNIA UPON DISCONTINUATION OF DARIDOREXANT IN PATIENTS WITH INSOMNIA

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Introduction: Abrupt discontinuation of sleep medications in patients with insomnia often causes withdrawal symptoms and rebound insomnia. In a Phase 3 program evaluating efficacy and safety of daridorexant on sleep and daytime functioning in patients with insomnia during 3 months of treatment, the risks of withdrawal symptoms and rebound insomnia were evaluated at treatment cessation.
Methods: In two randomized, double-blind, 3-month trials, adult (18–64 years) and elderly (≥65) patients with insomnia were assigned (1:1:1) to receive oral daridorexant 25mg, 50mg or placebo (Trial-1, NCT03545191) or 10mg, 25mg or placebo (Trial-2, NCT03575104) every evening. Each trial included a 7-day, single-blind, placebo run-out period following double-blind treatment to evaluate withdrawal symptoms and rebound insomnia. Withdrawal effects were assessed by the change in Benzodiazepine Withdrawal Symptom Questionnaire (BWSQ) total score, from last assessment on double-blind treatment to end of placebo run-out, and occurrence of relevant adverse events (AEs). Rebound insomnia was assessed objectively by change in wake-after-sleep-onset (WASO) and latency-to-persistent sleep (LPS), from baseline to first night of placebo run-out, and by subjective total-sleep-time (sTST), from baseline to end of run-out (mean of 7-days). Analyses included all patients who received ≥1 dose of placebo run-out treatment (Trial-1: N=852; Trial-2: N=851).
Results: No increase in mean BSWQ score from last assessment on double-blind treatment to end of placebo run-out was reported (Trial-1: 25mg, -0.6±2.3; 50mg, -0.6±2.3; placebo, -0.7±2.3; Trial-2: 10mg, -0.5±2.6; 25mg, -0.4±1.9; placebo, -0.4±1.4). No patients had a BWSQ score >20 at end of run-out. No AEs suggestive of withdrawal symptoms were reported. Mean WASO and LPS values (min) decreased from baseline to placebo run-out (WASO Trial-1: 25mg, -8.6±55.5; 50mg, -2.5±52.4; placebo, -20.4±45.8; Trial-2: 10mg, -11.6±58.3; 25mg, -5.1±57.9; placebo, -26.2±53.5; LPS Trial-1: 25mg, -17.2±56.7; 50mg, -15.0±55.8; placebo, -27.8±47.2; Trial-2: 10mg, -17.3±67.2; 25mg, -10.3±67.3; placebo, -18.3±63.8) while sTST values (min) increased (Trial-1: 25mg, 43.3±53.8; 50mg, 42.9±59.6; placebo, 42.3±52.7; Trial-2: 10mg, 43.3±52.9; 25mg, 46.8±55.4; placebo, 42.3±53.8) indicating absence of rebound effects.
Conclusion: Treatment with daridorexant for up to 3-months was not associated with any evidence of drug withdrawal or rebound insomnia upon abrupt discontinuation, indicating no safety concerns for patients should treatment be stopped.
Support (if any): Funded by Idorsia Pharmaceuticals Ltd.

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COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA IN PATIENTS WITH CHRONIC PAIN - A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Patients with chronic non-cancer pain often report insomnia as a significant comorbidity. Cognitive behavioral therapy for insomnia (CBT-I) is recommended as the first line of treatment for insomnia, and several randomized controlled trials (RCTs) have examined the efficacy of CBT-I on various health outcomes in patients with comorbid insomnia and chronic non-cancer pain. We conducted a systematic review and meta-analysis on the effectiveness of CBT-I on sleep, pain, depression, anxiety and fatigue in adults with comorbid insomnia and chronic non-cancer pain.
Methods: A systematic search was conducted using ten electronic databases. The duration of the search was set between database inception to April 2020. Included studies must be RCTs assessing the effects of CBT-I on at least patient-reported sleep outcomes in adults with chronic non-cancer pain. Quality of the studies was assessed using the Cochrane risk of bias assessment and Yates quality rating scale. Continuous data were extracted and summarized using standard mean difference (SMD) with 95% confidence intervals (CIs).
Results: The literature search resulted in 7,772 articles, of which 14 RCTs met the inclusion criteria. Twelve of these articles were included in the meta-analysis. The meta-analysis comprised 762 participants. CBT-I demonstrated a large significant effect on patient-reported sleep (SMD = 0.87, 95% CI [0.55–1.20], $p < 0.00001$) at post-treatment and final follow-up (up to 9 months) (0.59 [0.31–0.86], $p < 0.0001$); and moderate effects on pain (SMD = 0.20 [0.06, 0.34], $p = 0.006$) and depression (0.44 [0.09–0.79], $p= 0.01$) at post-treatment. The probability of improving sleep and pain following CBT-I at post-treatment was 81% and 58%, respectively. The probability of improving sleep and pain at final follow-up was 73% and 57%, respectively. There were no statistically significant effects on anxiety and fatigue.

Conclusion: This systematic review and meta-analysis showed that CBT-I is effective for improving sleep in adults with comorbid insomnia and chronic non-cancer pain. Further, CBT-I may lead to short-term moderate improvements in pain and depression. However, there is a need for further RCTs with adequate power, longer follow-up periods, CBT for both insomnia and pain, and consistent scoring systems for assessing patient outcomes.
Support (if any):

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OPIOID USE AND ABUSE ARE ASSOCIATED WITH USE OF SEDATIVE HYPNOTIC MEDICATIONS

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Introduction: The Department of Health and Human Services recently reported that 10.3 million people misused opioid drugs in 2018. Recent research attributed 21% of the deaths from opioid overdose to benzodiazepines. The overdose data and clinical experience show that opioid misusers commonly complain of insomnia and use hypnotic medications to self-medicate their sleep disturbance. At the same time, it remains unclear from a scientific perspective whether those who use/abuse opioids are more likely to use drugs in the sedative-hypnotic medication category. Consequently, the present study explores the relationship between comorbid use of opioids and sedative-hypnotic medications.
Methods: We extracted data from the 2015–2018 waves of the National Survey on Drug Use and Health (N=171,766). The primary outcome was the use of sedative-hypnotic medications, either in the z-class (zaleplon, zolpidem, eszopiclone) or sedating benzodiazepines (temazepam, flurazepam, triazolam). The primary exposures were prescription use of an opioid or abuse of an opioid (i.e., use of an illegal opioid such as heroin or misuse of a prescription opioid). Covariates included age, sex, race, income, education, and predicted mental illness category (none, mild, moderate, severe). Exposures were balanced on covariates using inverse probability of treatment weighting. Sequential binomial logistic regression estimated the association between opioid use/abuse and sedative-hypnotic use after adjusting for covariates.
Results: Opioid use and abuse varied by age, sex, race, education, and income (all $p < 0.001$). When adjusted for age, sex, and race (Model 1), sedative benzodiazepine use was more common among opioid users (OR 4.4 [4.04–4.79] and opioid abusers (OR 11.9 [9.72–14.5]). The use of z-class drugs was also more prevalent in opioid users (OR 3.69 [3.48–3.89]) and abusers (OR 7.74 [6.97–8.60]). Further adjusting for income and education (Model 2) and mental illness category (Model 3) attenuated but did not eliminate these associations.
Conclusion: Individuals who use or abuse opioids are significantly more likely to receive a sedative-hypnotic medication, a finding that is of concern and one that also suggests that sleep disturbance is common in this population. Further research is needed to determine the underlying nature and prevalence of sleep continuity disturbances in this population.
Support (if any): VA grant IK2CX000855 and I01 CX001957 (S.C.).

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INFORMAL CAREGIVERS WITH INSOMNIA MAY BENEFIT FROM AN INSOMNIA TREATMENT USING AN ACCEPTANCE AND COMMITMENT THERAPY APPROACH

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Introduction: Insomnia among informal caregivers (providing care to family/friends) is common and associated with worse mental and physical health outcomes. Traditional cognitive behavioral therapy for insomnia may be challenging for caregivers whose beliefs about sleep may relate to beliefs and behaviors that are intertwined with their unique situation of caregiving. We examined whether an insomnia treatment using an acceptance and commitment (ACT) approach (i.e. committing to values-based actions toward goals vs. experiential avoidance of distressing emotions/thoughts) plus sleep restriction, stimulus control and sleep hygiene improves sleep, mental health, and daytime symptoms among caregivers.
Methods: We analyzed data from women veterans with insomnia who were informal caregivers (mean age=44 years [range 25–57]; N=6) and were participating in a clinical trial of an ACT-focused treatment (termed ABC-I). We measured: Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), Patient Health Questionnaire (PHQ-9), General Anxiety Disorder (GAD-7), 11 items assessing symptoms of daytime impairment due to poor sleep derived from the International Classification of Sleep Disorders-Third Edition, and the Acceptance and Action Questionnaire (AAQ). Student t-tests were used to compare outcomes between pre- and post-ABC-I.
Results: Caregivers showed significant improvements between pre- and post-ABC-I (all p-values<0.05) in the following outcomes: ISI (14.3±5.4 vs. 3.8±3.2), PHQ-9 (9.8±7.2 vs. 2.8±3.8), GAD-9 (9.0±6.6 vs. 2.0±1.8), and number of symptoms of sleep-related daytime impairment (6.8±4.0 vs. 3.8±3.5). Caregivers also showed improvement trends in PSQI (10.0±4.1 vs. 5.2±1.2, p=0.06) and AAQ score (24.0±12.7 vs. 16.2±8.0, p=0.05).
Conclusion: We found that caregivers with insomnia may benefit from ACT-based treatment in improving perceived sleep quality and insomnia, depression, anxiety, sleep-related daytime impairment and reduced experiential avoidance. This approach may increase motivation by linking the sleep program to core values, and acceptance and tolerance of emotions or thoughts may benefit caregivers with insomnia. Further studies using an ACT-based insomnia program are needed to test its effect in a larger sample of caregivers and evaluate benefits in terms of reduced stress and improved health.
Support (if any): VA HSR&D (Martin IIR 13-058-2 and RCS-20–191), NIA (K23AG055668, Song), NHLBI (K23HL143055, Martin) of the NIH, VAGLAHS GRECC, and VA Office of Academic Affiliations (Kelly; Carlson).

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FEASIBILITY OF HYPNOSIS AS ADJUNCTIVE TREATMENT FOR SUBJECTIVE SLEEP DISTURBANCE: A PILOT STUDY AND PROOF OF CONCEPT

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Introduction: Hypnosis-based interventions have been shown to have a positive impact on several dimensions of sleep health. However, current evidence is limited as only a paucity of studies included populations with sleep complaints. Here we present a pilot data set to demonstrate the feasibility of developing a hypnosis-based adjunctive treatment for subjective sleep complaints.
Methods: Eleven adults (42% female; mean age 45±16.87 years) who sought treatment at the Stanford Sleep Medicine Center or Center for Integrative Medicine for subjective sleep complaints received hypnosis as adjunctive treatment. Self-report questionnaires were used to assess the weekly frequency of subjective sleep disturbances experienced before and after treatment, as well as 5-point Likert scale ratings of

perceived qualitative improvement in symptom severity and overall sleep quality.
Results: Five participants (45%) reported a reduction in symptom frequency and severity after hypnosis treatment. All five participants attributed at least some of the improvement to hypnosis treatment. Most participants (63%) observed post-treatment improvements in their overall sleep quality. No participants reported adverse effects of hypnosis.
Conclusion: Results suggest hypnosis-based adjunctive treatment may be effective for alleviating subjective sleep disturbances. The findings serve as preliminary support for further randomly controlled trials in larger samples.
Support (if any):

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A DIRECT-TO-PATIENT MAILING ABOUT SEDATIVE-HYPNOTICS AND ONLINE CBT-I: PARTICIPANT REPORTED USE OF STUDY MATERIALS

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Introduction: Cognitive behavioral therapy for insomnia (CBT-I) is recommended as first-line treatment for chronic insomnia disorder for all adults. Older adults are often prescribed sedative-hypnotics (e.g., benzodiazepine receptor agonists, BRAs) for insomnia, despite observational studies showing these medications increase risk of falls, fractures, and cognitive decline. In an ongoing randomized controlled trial, we are testing "Sleep EducatioN Information Sent Directly to Patients (SEND)," a novel program combining direct-to-patient mailing with information about access to an online CBT-I resource, compared to a similarly structured control condition. In the current study, we surveyed participants in both groups to examine their self-reported use of intervention or control materials.
Methods: In the larger trial, 1,672 Veteran participants (aged >=65 years, receiving care from a Colorado VA facility, and prescribed a BRA) were randomized to receive the SEND intervention brochure with information on how to access a free, anonymous online CBT-I resource (n=836) or control condition brochure with information about general sleep education (n=836). Six months after the initial brochure mailing, all participants were mailed a blinded survey querying participants' recollection and use of the mailed materials. We used chi-squared tests to compare survey responses for SEND versus control groups.
Results: 354 surveys were returned by study participants (overall response rate: 21%; SEND: 172 [20%], control: 182 [22%]). Respondents were 94% male with mean age 71.7 years (no difference between groups). In the SEND group, 97 (56%) reported receiving the brochure, 18 (10%) visited the website, and 14 (8%) discussed the brochure with their provider. No significant differences between groups were observed in the number of participants who reported receiving the brochure (chi2=2.96, p=.085); visiting the website (chi2=0.0253, p=.874); or discussing the brochure with their provider (chi2=1.91, p=.167).
Conclusion: At 6-months follow-up, over half of participants recalled receiving a mailing about sedative-hypnotics. A modest number reported visiting the online CBT-I program and a similar number discussed the materials with their healthcare provider. Similar results between groups suggest successful blinding of the intervention and control participants. If successful, the SEND intervention may provide a low-touch, low-cost approach to address BRA over-use in some older adults.
Support (if any):

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TRENDS IN THE DRUG-SPARING EFFECTS FOR BENZODIAZEPINES AND PRESCRIPTION OPIOIDS AMONG INSOMNIA PATIENTS ON SUVOREXANT IN THE US.

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Introduction: Use of benzodiazepines to treat insomnia has been associated with serious side effects and abuse potential. Insomnia patients are at high risk of opioid abuse and better sleep patterns may help to reduce opioid use. This study examined the trend in the use of benzodiazepines and prescription opioids before and after initiation of suvorexant in insomnia patients.
Methods: The study analyzed 2015–2019, Optum Clinformatics Data Mart. Insomnia patients, identified using ICD-9/10 codes and prescribed suvorexant were included. The study included incident (newly diagnosed) and prevalent cohorts of insomnia patients. The proportion of patients on benzodiazepines or prescription opioids were calculated for 12 monthly intervals before (pre-period) and after initiation of suvorexant (post-period). Interrupted time series (ITS) analysis was conducted to assess trends for use of benzodiazepine or prescription opioids over time.
Results: A total of 5,939 patients from the incident insomnia cohort and 18,920 from the prevalent cohort were included. For the incident cohort, mean age was 64.47 (SD: 15.48), 63% were females, 71% had Medicare Advantage coverage, 59% had Charlson comorbidity index score (CCI) ≥ 1, 27% had an anxiety disorder and 16% had substance abuse disorder. Prevalent insomnia cohort was similar but had higher CCI. Results from ITS suggested that at the beginning of the pre-period, 28% of incident insomnia patients used either opioids or benzodiazepines with the rate of use in the pre-period increasing by 0.11% per month. In the post-period, the rate of use decreased by 0.33% per month. About 26% patients used benzodiazepines or opioids at 12-month after suvorexant initiation. In the absence of suvorexant, this proportion would have been 31%. Similar findings were observed for the prevalent insomnia cohort. A larger decrease was observed for opioid use than benzodiazepines.
Conclusion: The rate of benzodiazepines or prescription opioid use decreased over time after the initiation of suvorexant. Suvorexant has the potential to reduce the use of opioids and benzodiazepines among insomnia patients. Further research is needed to confirm these findings.
Support (if any): This study was sponsored by Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc., Kenilworth, NJ, USA.

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PREDICTORS OF LONGITUDINAL SLEEP OUTCOMES IN A STATEWIDE RANDOMIZED TRIAL OF TELEPHONE COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA

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Introduction: We examined the relationship between treatment process measures and 12-month insomnia outcomes from a large clinical trial of telephone-delivered CBT-I.
Methods: A statewide sample of 327 Kaiser Permanente Washington members aged 60+ with OA, Insomnia Severity Index (ISI) scores of 11+ and Brief Pain Inventory scores of 9+ were randomized to six sessions of individual telephone-delivered cognitive-behavior therapy for insomnia (CBT-I) vs. education-only control. Participants rated their perceptions of treatment credibility and perceived effectiveness on a 7-point Likert scale after session 1 and at 2-month post-test. They also completed the Sleep Hygiene Index (SHI), the 8-item Sleep Problem Acceptance Questionnaire (SPAQ), and the 8-item Chronic Pain Acceptance Questionnaire (CPAQ) at baseline, post-treatment, and 12 months. Insomnia outcome was measured using the ISI.
Results: Participants (mean age=70.2 years [SD=6.81], 74.6% female, 87.8% with sleep problems for over 1 year) were randomized to the two treatment arms. Regression analyses controlling for baseline age, opioid use, depression, pain, and ISI showed that lower 12-month ISI scores were associated with CBT-I group membership and lower baseline ISI (both p<.001), higher session 1 ratings of treatment credibility (p=.004), higher baseline CPAQ activity engagement (AE) subscale scores (p=.04), and lower baseline SPAQ AE scores (p=.016) when predictors were simultaneously entered. Lower 12-month ISI scores were also associated with post-test ratings of treatment perceived effectiveness (p=.004) and higher SPAQ AE (p=.038) scores. Improvements on the SHI at post-test were significantly associated with lower 12-month ISI scores when variables were entered singly into regression models, but not when all predictors were entered simultaneously. SPAQ and CPAQ sleep and pain willingness subscale scores were not significantly related to ISI outcomes in any model.
Conclusion: People with less severe baseline insomnia levels who received telephone-delivered CBT-I were more likely to have lower 12-month ISI scores. Participant perceptions of treatment credibility and effectiveness, and engagement in life activities despite pain and sleep symptoms were also associated with long-term improvements in insomnia, but willingness to experience sleep and pain symptoms were not contributing factors.
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EXAMINING USE AND BELIEFS ABOUT SLEEP MEDICATIONS IN A SAMPLE OF OLDER ADULTS: THE ROLE OF HYPNOTIC DEPENDENCY

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Introduction: Prevalence of insomnia and prescription of sleep medications increases in older adults and is associated with heightened risk of falls, cognitive and psychomotor detriments, and exacerbation of pre-existing conditions. The present study aimed to characterize beliefs about sleep and sleep medications, hypnotic self-efficacy, and hypnotic dependence in a sample of older adults with insomnia disorder.
Methods: Adults 50 years and older (N = 141) who met DSM-5 criteria for insomnia disorder were enrolled in the RCT of the Effectiveness of Stepped-Care Sleep Therapy In General Practice (RESTING) study. At baseline, participants completed the Beliefs about Medications Questionnaire (BMQ; subscales assess the belief that hypnotics are necessary and concern regarding consequences of use), Insomnia Severity Index (ISI), Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS), Pre-Sleep Arousal Scale (PSAS), and the Patient Health Questionnaire-4 (PHQ-4). Participants taking prescription sleep medications (n = 54) also reported if they had sedative hypnotic reduction goals and completed the Sleep Medications Dependency Scale and Hypnotic Self-Efficacy Scale.
Results: Those taking prescription sleep medications reported greater belief in the necessity of sedative hypnotics ($p < .001$, $d = 1.69$) and greater anxiety and depression ($p = .005$, $d = .57$) than those not taking prescription medications; groups did not differ significantly on the BMQ concern subscale, ISI, DBAS, or PSAS. 70.4% of participants using prescription sleep medications endorsed decrease in sedative hypnotic use as a treatment goal. Dependency on sleep medications, but not hypnotic self-efficacy, was greater in those with this goal ($p = .003$, $d = .94$). Higher levels of hypnotic dependence were associated with both greater concern ($r = .40$, $p = .003$) and belief in the necessity of sleep medications ($r = .48$, $p < .001$).
Conclusion: Our findings indicate that many treatment-seeking older adults with insomnia disorder take prescription sleep medications. They tend to believe in the necessity of sleep medications for controlling sleep disruption, but also identify medication reduction as a treatment goal, even if endorsing dependence on hypnotics. This highlights the importance of disseminating non-medication treatments that address both insomnia and reduction of sedative hypnotic use.
Support (if any): 1R01AG057500

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DARIDOREXANT DOES NOT IMPAIR RESPIRATORY FUNCTION IN PATIENTS WITH MILD/MODERATE OBSTRUCTIVE SLEEP APNEA IRRESPECTIVE OF SEVERITY

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Introduction: Daridorexant is a dual orexin receptor antagonist developed for the treatment of insomnia. The effect of the highest phase-3 dose of 50 mg daridorexant on nighttime respiratory function was evaluated in patients with mild/moderate obstructive sleep apnea (OSA). This study showed that repeated doses of daridorexant had no clinically meaningful effect on nighttime respiration (i.e., apnea-hypopnea index [AHI] and peripheral oxygen saturation [SpO2]). In the same study, other relevant respiratory endpoints were evaluated.
Methods: In this randomized, double-blind, placebo-controlled, two-period, crossover study, daridorexant or placebo was administered in each period once daily for 5 consecutive nights to 28 patients. Treatment differences (daridorexant – placebo) for total number and mean/longest duration of apneas and hypopneas as well as mean and lowest SpO2 during apnea/hypopnea events in Night 5 were explored using linear mixed-effects modeling. Treatment differences for the above-mentioned endpoints versus AHI during TST at baseline (i.e., OSA severity) was analyzed by linear regression using least square approach.
Results: Of 28 patients enrolled, 25 completed the study and were included in the analysis (n=15/10 with mild/moderate OSA; mean [standard deviation, SD] AHI: 16.3 events/h [8.2]). Compared to placebo, daridorexant increased mean duration of TST and accordingly to a not statistically significant extent the mean number of apneas + hypopneas by 16.4 events (n=103 versus 86.2; 90% confidence interval [CI]: -0.4–33.2]) without difference in mean [SD] AHI between daridorexant (15.1 events/h [7.9] and placebo (14.2 [7.7]). No treatment difference was detected for mean (0.0 sec [-2.6–2.7]) or longest

(0.8 sec [-8.9–10.5]) duration of apneas nor for mean (0.2 sec [-2.2–2.5]) or longest (8.3 sec [6.4–23.1]) duration of hypopneas. No treatment difference was observed for mean (0.3% [-0.2–2.1]) and lowest (0.9% [0.3–2.1]) SpO2 during apnea/hypopnea events. Treatment differences for any of the evaluated endpoints did not significantly correlate with AHI at baseline as a marker of OSA severity ($r2 \leq 0.09$).
Conclusion: Daridorexant can safely be administered to patients with mild/moderate OSA as treatment differences for respiratory-related endpoints were not of statistical significance and independent of disease severity in the studied population.
Support (if any): Funded by Idorsia Pharmaceuticals Ltd.

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DARIDOREXANT IMPROVES SLEEP IN PATIENTS WITH MILD/MODERATE OBSTRUCTIVE SLEEP APNEA

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Introduction: Daridorexant is a dual orexin receptor antagonist developed for the treatment of insomnia. The effect of the highest phase-3 dose of 50 mg daridorexant on nighttime respiratory function was evaluated in patients with mild/moderate obstructive sleep apnea (OSA). This study showed that repeated doses of daridorexant had no clinically meaningful effect on the apnea-hypopnea index (AHI) or on peripheral oxygen saturation. In the same study, the effect on objective sleep parameters was also explored by polysomnography (PSG).
Methods: In this randomized, double-blind, placebo-controlled, two-period, crossover study, daridorexant or placebo was administered in each period once daily for 5 consecutive nights to 28 patients. Treatment difference (daridorexant – placebo) for total sleep time (TST), latency to persistent sleep (LPS), and wake after sleep onset (WASO) was analyzed for Night 5 using linear mixed-effects modeling. In addition, sleep was further explored based on sleep duration during each hour of PSG recording, duration of the different sleep phases (rapid eye movement [REM], non-REM [including N1 to N3 sleep stages]), as well as number and mean/longest duration of awakenings.
Results: Of 28 patients enrolled, 25 completed the study and were included in the analysis (n=15/10 with mild/moderate OSA; mean [standard deviation] AHI: 16.3 [8.2] events/h). One patient had mild insomnia symptoms at baseline. Compared to placebo, daridorexant prolonged mean TST by 38.8 min (90% confidence interval: 19.7–57.9), shortened mean LPS by 17.2 min (-35.5–1.02), and reduced mean WASO by 31.0 min (-47.3 to 14.7). Sleep architecture was maintained as no treatment differences in the duration of the evaluated sleep stages were observed when normalized to TST. Sleep duration was prolonged in the second part of the night. mean and longest duration of awakenings were decreased by a mean (90% CI) of 2.0 min (-3.1 to 0.9) and 16.3 min (-24.1 to -8.6), respectively, without treatment difference for the total number of awakenings.
Conclusion: Daridorexant improved objective sleep parameters in patients with mild to moderate OSA without modifying sleep architecture.
Support (if any): Funded by Idorsia Pharmaceuticals Ltd.

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TAILORING OF COGNITIVE BEHAVIOR THERAPY FOR INSOMNIA FOR PATIENTS WITH KIDNEY FAILURE UNDERGOING HEMODIALYSIS: THE SLEEP-HD STUDY

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Introduction: Patients with kidney failure treated with hemodialysis (HD) frequently report insomnia symptoms. Cognitive-behavior therapy for insomnia (CBT-I) is a first line treatment for insomnia but there are unique issues surrounding kidney failure and HD that impact patients' ability to access CBT-I and follow standard treatment recommendations. This presentation describes CBT-I protocol modifications made to address these issues as part of an ongoing multi-center clinical trial testing the efficacy of telehealth CBT-I compared to trazodone or medication placebo control.
Methods: CBT-I protocol modifications were made prior to starting the SLEEP-HD randomized trial based upon unique clinical considerations for HD patients, e.g., irregular sleep-wake scheduling that HD treatment demands, and napping during HD sessions or afterwards due to post-HD treatment fatigue. Participants in the SLEEP-HD study are undergoing thrice-weekly maintenance hemodialysis for >3 months and have baseline Insomnia Severity Index scores >10 with sleep disturbances >3 nights/week for >3 months. Participants randomized into the modified CBT-I protocol receive six weekly sessions, delivered by trained CBT-I therapists (1 MSW, 1 PhD) face-to-face via a HIPPA-compliant video telehealth platform. Participants keep a daily sleep diary throughout the CBT-I treatment period.
Results: To date, 91 patients (mean age=56.5 years [SD=14.7], 48.4% female) recruited from community-based dialysis facilities in Seattle and Albuquerque have been randomized into the SLEEP-HD study (n=31 CBT-I). Forty-eight percent of CBT-I clients have chosen to conduct their telehealth sessions during dialysis with the remainder choosing a different location. CBT-I adaptations include therapists developing weekly bed restriction recommendations based on non-dialysis treatment days; allowing shifts in dialysis day "bed window" scheduling for patients with very early or very late dialysis schedules so long as a consistent total time in bed in maintained; and including napping during early/late dialysis sessions as part of the allowable bed window duration. Treatment modifications were also designed to accommodate the diverse socioeconomic circumstances of dialysis patients, including housing instability, which can impact adherence to some standard stimulus control and bed restriction CBT-I recommendations.
Conclusion: It is feasible to deliver CBT-I via telehealth to HD patients but modifications to standard protocols are required.
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EFFICACY OF CBT-I AND ITS COMPONENTS ON HEALTH-RELATED QUALITY OF LIFE OUTCOMES IN OLDER ADULTS

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Introduction: Insomnia affects 30–48% of older adults and impairs health-related quality of life (HRQoL). Numerous studies report Cognitive Behavioral Therapy (CBT-I) as an effective non-pharmacological treatment for insomnia symptoms, with few examining the impact of CBT-I on mental and physical aspects of HRQoL. While limited research suggests that CBT-I leads to improvements in

HRQoL, the impact of the cognitive versus behavioral components of CBT-I on HRQoL is unknown.
Methods: 128 older adults with insomnia (mean age=69, 66% female, 19% minority) were randomized to receive cognitive therapy (CT), behavior therapy (BT), or CBT-I. The Short Form (36) Health Survey (SF-36) was collected at baseline, post-treatment and six-month follow-up. Split-plot linear mixed models with age and sex as covariates to assess within and between subject changes were used to test intervention, time, and interaction effects on the mental health and physical well-being domains of HRQoL. Significance for all effects was defined as $p < 0.05$. The effect size (d) was calculated by dividing the difference between means by the root-mean-squared error of the mixed effects model.
Results: The mental health-related QoL improved over time independent of treatment (Main effect of time: $F(2, 202) = 6.51$, $p < 0.002$). The interaction failed to reach significance (Interaction: $F(4, 202) = 1.19$, $p = .31$). Simple effects revealed significant improvements among CBT-I participants at six months ($p = .02$, $d = .53$) and CT participants at post-treatment ($p = .00$, $d = .79$) and six months ($p = .03$, $d = .66$), but not among BT participants for either time point ($p = .32$, $d = .24$; $p = .16$, $d = .35$). Treatment did not improve physical health-related QoL over time ($F(2, 202) = 1.01$, $p = .37$) nor was there a significant interaction ($F(4, 202) = .46$, $p = .76$).
Conclusion: These findings suggest that CBT-I, particularly the CT component, may be effective in improving mental health-related QoL outcomes for older adults with insomnia. In contrast, neither CBT-I nor its component treatments were effective in improving physical health-related QoL.
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RELATIVE EFFECTIVENESS OF COGNITIVE BEHAVIORAL THERAPY AND ITS COMPONENTS IN IMPROVING INSOMNIA SYMPTOMS IN OLDER ADULTS

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Introduction: The prevalence of insomnia complaints in older adults is 30–48%, compared to 10–15% in the general population. Cognitive Behavioral Therapy for Insomnia (CBT-I) is a first-line, non-pharmacological sleep treatment for Insomnia. However, the relative impact of Behavioral (BT) and Cognitive (CT) components compared to that of CBT-I in older adults is unknown.
Methods: 128 older adults with insomnia were randomized to receive CBT-I, BT, or CT. Sleep diaries and the Insomnia Severity Index (ISI) were collected pre- and post-treatment and at a 6-month follow-up. We conducted split-plot linear mixed models with age and sex as covariates to assess within and between subject changes to test effects of group, time, and their interaction on ISI, sleep onset latency (SOL), wake after sleep onset (WASO), total sleep time (TST), time in bed (TIB), sleep efficiency (SE), and percent of treatment responders (ISI decrease>7) and remitters (ISI<8). Effect size (d) was calculated by dividing the difference between means by the root-mean-squared error of the mixed effects model.
Results: All treatments lead to a significant improvement across outcome measures at post-treatment (p's<0.001) and 6-months (p's<0.01), with the exception of TIB, response, and remission. For TIB, there was a significant Group x Time interaction ($p<0.001$): while all treatments significantly reduced TIB post-treatment relative to baseline, CBT-I ($p<0.001, d=-2.26$) and BT ($p<0.001, d=-1.59$) performed significantly better than CT ($p=0.003$, $d=-0.68$). In contrast, at 6-months CBT-I ($p<0.001, d=-1.16$) performed significantly better at reducing TIB than CT ($p=0.195, d=-0.24$) or BT ($p=0.023, d=-0.61$) relative to baseline. There was also a non-significant trend for a Group x Time interaction for remission status ($p=0.062$). Whereas, the percentage of remitters within all groups post-treatment did not differ from chance ($p>0.234$), at 6 months, the percentage of remitters was significantly higher than chance in CBT-I (73.63%, $p=0.026$) and BT (78.08%, $p=0.012$), but not CT (47.85%, $p=0.826$). There were no other significant time or interaction effects (all $p>0.05$).
Conclusion: CBT-I and its components are effective in improving subjective insomnia symptoms in older adults. Evidence suggests CBT-I may be superior to either CT or BT alone in improving TIB in older adults.
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EFFICACY OF SLEEP HYGIENE ADVICES FOR INDIVIDUALS WITH POOR SLEEP QUALITY

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Introduction: Though sleep hygiene practice is a promising approach to individuals with poor sleep quality, less research has been done in different ethnic population regarding the effect of sleep hygiene in individuals with poor sleep quality. Aim: To investigate the efficacy of sleep hygiene among individuals with poor sleep quality
Methods: Methodology: This was a prospective study of 250 participants from different ethnic populations using the Pittsburgh Sleep Quality Index (PSQI). Sleep hygiene advices were given online to the individuals with poor sleep quality (PSQI > 5). Post- test of PSQI score was done after 8 weeks following the Sleep hygiene practices. Survey was done online through google forms and the score was calculated and the level pf sleep quality was sent to the participants (good or poor). A cut of value of PSQI 5 was taken in to consideration. .Questionnaire was sent to participants through snowball sampling.
Results: Results There were 250 participants in this study and the sleep quality index was found to be significantly different ($p<0.001$) between pre- and post-intervention (Sleep hygiene advice). Age was 30.21±10.70 (mean ± SD) years and there were 157 (63%) females and 93 (37%) males. There were participants from 16 countries, majority responses from India, Saudi and Philippines. PSQI was 8.58 ± 2.49 before the sleep hygiene advice and 5.74± 1.86 post sleep hygiene practice. There was a significant improvement in the sleep quality. Significant correlation was seen between global PSQI score and the 7 components of the PSQI scoring.
Conclusion: Conclusion: Sleep hygiene can help in improving the sleep quality of individuals with poor sleep quality
Support (if any):

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THE APNEA AND INSOMNIA RESEARCH (AIR) TRIAL: AN INTERIM REPORT

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Introduction: Many sleep apnea patients suffer from comorbid insomnia disorder. Although cognitive behavioral insomnia therapy (CBTI) is recommended as the first line insomnia treatment for such

patients, access to trained providers of this treatment remains limited. The current study is testing he efficacy of an online CBTI among CPAP treated sleep apnea patient with comorbid insomnia.
Methods: Patients enrolled in this trial complete baseline measures and then are randomized to either an online version of Cognitive Behavioral Insomnia Therapy (CBTI) or no additional treatment beyond their CPAP therapy (CTRL). After 8 weeks of treatment all patients are reassessed. The current report considers changes in scores on the ISI and Epworth Sleepiness Scale (ESS) as well as average minutes of nightly CPAP use from pre-treatment to the end of the initial 8 weeks of online treatment relative to the no treatment CTRL. The sample for this report included the first 276 participants enrolled in this trial (mean age = 56.5±12.5 yrs; 58.7% females).
Results: Those receiving online CBTI showed greater reductions in their ISI scores from baseline to the end of the initial 8-week treatment phase than did those in the CTRL group (p = .0001). Average ISI score improvements among those receiving online CBTI moved patients from moderately severe insomnia to mild insomnia symptoms. In contrast, no differences were noted between the online CBTI and CTRL groups in regard to pre- to post-treatments changes on the ESS (p= .2541) scores or amount of CPAP use (p = .4383).
Conclusion: Whereas online CBTI does not seem to reduce daytime sleepiness or improve CPAP adherence among patients with comorbid sleep apnea and insomnia, it appears to be an effective intervention for reducing insomnia severity for this patient group.
Support (if any): National Heart. Lung and Blood Institute Grant # 1R01HL130559-01A1

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USE OF BLINDED HYPNOTIC TAPERING FOR HYPNOTIC DISCONTINUATION: FINAL REPORT

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Introduction: Many patients have difficulties achieving hypnotic discontinuation due to anxiety that arises when they knowingly reduce their hypnotic dose or withhold it entirely. This study tested a blinded tapering approach to reduce patients' anxiety and help them discontinue their hypnotics.
Methods: The study sample included 78 (M age = 55.2 ± 12.8 yrs.; 65.4% women) users of benzodiazepine and benzodiazepine receptor agonists. Following baseline assessments, enrollees first completed 4 sessions of cognitive behavioral insomnia therapy (CBTI). Subsequently they were randomized to one of three 20-week, double-blinded tapering protocols wherein their medication dosage either remained unchanged (CTRL) or was reduced by 25% or 10% every two weeks. At the end of the 20-week period the study blind was eliminated and those who completed one of the two blinded tapering protocols entered a 3-month follow-up period, whereas CTRL participants were offered an open label taper before completing the follow-up.
Results: Among those who completed one of the blinded tapering protocols, 92.9% totally discontinued their medication use by the end of the 20-week tapering phase, whereas 77.3% in the CTRL group discontinued hypnotic use by the end of their open label tapering. At follow-up 72.1% of those who completed blinded tapering remained medication free whereas only 52% of those who underwent open-label tapering remained medication free. Comparisons at follow-up showed those who received the open-label taper continued to use hypnotics on average 2.06 nights/week compared to .051 times per week for the blinded taper group (p = .042). The average weekly diazepam equivalent dose of medication used by the open label tapering group was 11.29 mg whereas the weekly dose for the blinded tapering group was 3.22 (p = .069).
Conclusion: CBTI combined with blinded hypnotic tapering is a promising treatment approach for helping hypnotic users overcome their medication dependence.
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COGNITIVE BEHAVIORAL THERAPY AND LIGHT DARK THERAPY FOR POSTPARTUM INSOMNIA SYMPTOMS: FINDINGS FROM A RANDOMIZED CONTROLLED TRIAL

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Introduction: Symptoms of insomnia are common in the postpartum period and are associated with a range of negative outcomes. Despite this, interventions to improve maternal postpartum sleep remain scarce. Cognitive Behavioral Therapy (CBT) and Light Dark Therapy (LDT) target two different mechanisms to reduce sleep disturbance. This randomized controlled trial examined the efficacy of CBT and LDT against a treatment-as-usual (TAU) condition in reducing maternal postpartum insomnia symptoms.
Methods: Nulliparous women 4–12 months postpartum with self-reported symptoms of insomnia (Insomnia Severity Index scores [ISI] >7) were included; excluded were those with: current severe health/psychiatric conditions, unsettled infant behaviors, sleep-affecting medication use and photosensitivity. Eligible women were randomized 1:1:1 to 6 weeks of CBT (CBT for insomnia and fatigue), LDT (morning bright light therapy, evening light hygiene), or TAU. Interventions were therapist-assisted and personalized through two telephone calls and included automated self-help intervention materials (i.e., emails) delivered over six weeks. Symptoms of insomnia (ISI; primary outcome), fatigue, sleepiness, depression, and anxiety were assessed at baseline, mid-intervention, post-intervention, and 1-month post-intervention. Analyses were intention-to-treat latent growth models.
Results: 114 women were randomized (mean age = 32.20 ± 4.62 years) and 108 women completed the intervention. Compared to TAU, symptoms of insomnia significantly reduced from baseline to post-intervention in both CBT and LDT groups (p-values <.001), with very large effect sizes (d > 1.5) at post-intervention; gains were maintained at follow-up. Fatigue symptoms significantly reduced in the CBT group (p<.0001; d = 0.85) but not LDT (p = 0.11) compared to TAU at post-intervention; gains were maintained for CBT at follow-up. Group differences in sleepiness, depression, and anxiety were nonsignificant (all p > 0.08).
Conclusion: Therapist-assisted self-help CBT and LDT with different therapeutic mechanisms are both efficacious for reducing maternal insomnia symptoms during the postpartum period. Findings were mixed for fatigue, sleepiness and mood. Future research on predictors of treatment responses is needed.
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PREDICTORS OF DROPOUT IN UNIVERSITY STUDENTS PARTICIPATING IN AN 8-WEEK E-MAIL BASED COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA

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Introduction: As dropout from treatment potentially diminishes its therapeutic effect and poses clinical concern, it is important to find out which characteristics of participants are suitable for online-based treatment. Therefore, we aimed to identify factors that predicted a dropout in the e-mail based cognitive behavioral therapy (REFRESH) developed by Stanford University for the purpose of psychological intervention for insomnia.
Methods: Participants who participated in the REFRESH program consisted of 158 university and graduate students aged 18 to 30 in Hong Kong and Korea who scored higher than 10 on the Insomnia Severity Index (ISI), and the intervention was delivered in 8 weekly sessions sent via weekly e-mails. Among them, 110 were women (70%) and the average age was 22 (±2.71) years old. All participants were asked to answer the following self-reporting questionnaires before and after the intervention: Insomnia Severity Index; ISI, Depression Anxiety Stress Scale 21; DASS-21, Sleep Hygiene Practice Scale; SHPS, Dysfunctional Beliefs and Attitude about Sleep 16; DBAS-16. Descriptive statistics and ROC decision tree analysis were conducted to address our aim.
Results: Of the 158 participants, 68 completed the program, and 90 participants (57%) dropped out. The best predictor of dropout was DASS score with an optimal cup-point of <34. Of the 107 participants who reported DASS <30, 70(65.4%) dropped out. In contrast, of the 50 participants who reported DASS ≥34, 12(38%) dropped out. The second-level predictor was expectations for sleep score with a cut-point of <18. Among participants with DASS <34 and expectations for sleep score <18, 57(73.1%) dropped out. Of the 29 participants who reported DASS <34 and expectations for sleep score ≥18, 13(44.8%) dropped out.
Conclusion: Mild levels of depression, anxiety and stress and expectations for sleep appear to be predictive of dropout in an e-mail based intervention. People with mild symptoms may experience less distress and impairment, which may result in lower motivation to receive treatment. This may lead to inability to complete treatment and higher rates of dropout.
Support (if any):

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A SLEEP HYGIENE AND RELAXATION TRAINING PROGRAM AFTER THE GREAT EAST JAPAN EARTHQUAKE: WHAT ASPECTS OF SLEEP COULD BE IMPROVED?

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Introduction: After a natural disaster, the incidence of sleep difficulties tends to increase. Specifically, the prevalence of suspected insomnia was reported to have increased among disaster victims after the Great East Japan Earthquake of March 11, 2011. In a previous study, we have reported that education on sleep hygiene and relaxation training was effective in improving nighttime sleep in students of universities in Sendai city after the earthquake of March 2011. According to analyses of subscale scores of the Pittsburgh Sleep Quality Index (PSQI), the present study aimed to determine what aspects of sleep difficulties were successfully improved.
Methods: University undergraduates and graduates who reported having sleep difficulties were asked to respond to a questionnaire including the PSQI thrice, before attending a 90-min lecture on sleep hygiene and relaxation training, and a month and three months after attending the program. All participants who reported the total PSQI score of the cutoff point (6) or more were divided into two groups based on their PSQI scores before the program, that attending the course and that not attending it, that is, the "waiting list" group.
Results: The "attending" group exhibited a decrease in the total PSQI score in the first month after attending the program, and the score in this group reduced further three months later; Nine of twenty (45.0%) attending participants reported the score of less than 6 after a month, while only three of seventeen (17.6%) wait-list participants did. The PSQI subscale scores reported by the nine successful attending participants indicated a significant decrease in the subscale scores on subjective sleep quality, sleep latency, sleep duration, and sleep disturbance from before the program to one month later.
Conclusion: These results suggest that the short course on sleep hygiene and relaxation training intended for university students was effective, and about a half of the attended participants reported the PSQI score of less than the PSQI cutoff score one month later. This substantial effect would be mainly based on the improvement of their subjective sleep quality, latency, duration, and disturbance.
Support (if any): This study was supported by a research grant from the Japanese Psychological Association, Tokyo, Japan.

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DURABILITY OF TX RESPONSE TO ZOLPIDEM USING A PARTIAL REINFORCEMENT REGIMEN: DOES THIS STRATEGY REQUIRE CONTINGENT REINFORCEMENT?

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Introduction: In 2015, partial reinforcement (PR) was assessed as an alternative approach to maintenance therapy with zolpidem. The method being: once a treatment response is obtained over the course of 1-month's Tx with QHS dosing (Phase-1), Tx response can maintained over time with a PR regimen (Phase-2 [nightly pill/capsule use with 50% of capsules having medication and 50% having only inert filler]). In that study, it was assumed that Phase1 QHS dosing was required 1) to maximize treatment responding and 2) for the conditioning of pharmacologic responses to the medication vehicle (capsule). In the present study, these assumptions were tested by including both QHS and PR arms into Phase-1.
Methods: In Phase-1 (1 month), subjects were randomized to the QHS or PRS conditions (2QHS:1PRS). In Phase-2 (3 months), the PRS group continued forward without a change in the treatment regimen (variable dose [VD-VD]) and the QHS group was re-randomized to either continued QHS Tx (full dose [FD-FD]) or to PRS Tx [FD-VD]). Both study phases were evaluated for treatment responses rates and for average change in TWT (SL+WASO+EMA).
Results: 55 subjects (age 61.2+/-8.1, 64% female, & 73% white) were enrolled into Phase-1; 39 were randomized to the QHS condition and 16 to the PRS condition. In Phase-1, 77% (QHS) and 50% (PRS) exhibited treatment responses (p=0.09) where the average change in TWT was similar by group (QHS was -43min [CI -76,-9] and PRS was -76min [CI -138,-14];p=0.35). In Phase-2, 73% (FD-FD), 57% (FD-VD), and 88% (VD-VD) exhibited continued treatment responses (p=0.22) where the average improvement of TWT continued with FD-FD and remained stable for FD-VD and VD-VD (p<0.01).
Conclusion: These data, while preliminary, suggest that QHS (vs. PRS) dosing produces more treatment responders and similar initial effects on sleep continuity during Phase-1, comparable maintenance of treatment response over time, and continued improvement on sleep continuity during Phase-2. These results suggest that partial reinforcement can maintain effects but cannot allow for the additional clinical gains afforded by continuous treatment. Given this, it may be the case

that the partial reinforcement technique could be improved upon by extending phase from 1 to 2–4 months.
Support (if any):

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INSOMNIA WITH OBJECTIVE SHORT SLEEP DURATION IS ASSOCIATED WITH INCREASED CORTISOL IN PATIENTS WITH MILD COGNITIVE IMPAIRMENT

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Introduction: Mild cognitive impairment (MCI) is frequent in the elderly and is in a continuum with dementia in a significant amount of people. Both insomnia and increased cortisol levels have been suggested as risk factors for MCI. The goal of this study was to examine whether activation of the hypothalamic-pituitary-adrenal (HPA) axis, as measured by plasma cortisol levels, is associated with the insomnia with short sleep duration (ISS) phenotype, as measured by actigraphy, in elderly with MCI.
Methods: A sub-sample of 109 subjects with MCI and 92 cognitively non-impaired controls 60 years or older (75.37±6.54y) was recruited from a population-based cohort residing on Crete, Greece. Subjects underwent medical history, physical examination, neuropsychiatric evaluation, neuropsychological testing, 3-day 24-h actigraphy, assessment of subjective insomnia symptoms (i.e., difficulties initiating and/or maintaining sleep), and a morning blood draw to assay for plasma cortisol levels. The ISS phenotype was defined by the presence of at least one insomnia symptom and an actigraphy-measured sleep efficiency below the median of the entire sample (i.e., ≤81%). Group differences in plasma cortisol levels between MCI subjects with and without the ISS phenotype were tested using ANCOVA adjusting for age, gender, BMI and depression.
Results: Subjects with MCI had higher cortisol levels compared to controls (105.34±9.34 vs. 70.3±10.02 nmol/L, $p<0.05$). Subjects with MCI and the ISS phenotype (138.38±16.57 nmol/L) had significantly higher cortisol levels compared to those without insomnia (97.74±19.68 nmol/L) or those with insomnia and normal sleep duration (INS; 79.97±16.02 nmol/L, $p=0.044$). The association between the ISS phenotype and cortisol levels was modified by amnestic symptoms (p-interaction=0.079); commensurate, the ISS phenotype was associated with higher cortisol levels among the amnestic MCI subgroup (INS: 79.12±21.93 vs. ISS: 155.55±20.40 nmol/L, $p=0.040$), but not among the non-amnestic MCI subgroup (INS: 64.06±23.62 vs. ISS: 89.33±29.00 nmol/L, $p=0.559$).
Conclusion: The ISS phenotype is associated with increased cortisol levels in elderly with MCI, particularly those with amnestic type. Improving sleep quality, decreasing cortisol levels and lengthening sleep duration may slow down the progression of these individuals into dementia.
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DEPRESSIVE SYMPTOMS IN THE CONTEXT OF COGNITIVE-BEHAVIORAL THERAPY FOR INSOMNIA, A LONG-TERM FOLLOW-UP STUDY.

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Introduction: Cognitive-Behavioral Therapy for Insomnia (CBT-I) is considered the first-choice treatment for Insomnia Disease (ID). The bi-directional causal relationship between insomnia and depression is recognized. Aim of our study is to investigate the role of depressive symptoms in predicting CBT-I outcomes, and the effectiveness of the treatment both on insomnia and depression.
Methods: 77 ID patients (mean age 38.2±10.4 years, 69.2% females) underwent 7-sessions group CBT-I and were assessed pre- (T0) post- (T1) and at long-term after CBT-I (T2=7.6±1.6 years after treatment). The primary outcomes are Insomnia Severity Index (ISI) and Sleep Diary parameters. The secondary outcome is Beck Depression Inventory-II (BDI). Patients were divided in two groups according to BDI baseline score (≥14): depressive (D) vs non-depressive (ND).
Results: All patients showed significant improvements at ISI score at T1 that were maintained at T2 (T0=16.2±4.8 vs T1=8.2±4.5 vs T2=10.0±6.1;$p<0.001$). Also Sleep Diary parameters (sleep latency, wake after sleep onset and sleep efficiency) showed significant improvement at T1 ($p<0.001$). Moreover all patients showed improvements of depressive symptoms at T1 that were maintained at T2 (T0=10.8±6.8 vs T1=6.2±5.5 vs T2=8.2±6.6; $p<0.001$). Indeed, if 29.3% if ID patients at T0 presented clinically significant depressive symptoms (BDI≥14), only 9.7% at T1 and 20.5% at T2. Nevertheless, we found an interaction between ISI along time (T0-T1-T2) and D vs ND group membership (ISI_TREAT*BDI_BL_GROUP Sig=$p<0.05$). In other words, group D patients at baseline showed a worsening of insomnia symptoms at the long-term evaluation (T2).
Conclusion: CBT-I showed improvements both in insomnia and in depressive symptoms at the end of treatment that are maintained at long-term (7.6yrs after treatment). Nevertheless, clinically significant depressive symptoms at the baseline predicted a worsening of insomnia at the long-term evaluation. This could suggest the need of a more frequent follow-up evaluation of CBT-I efficacy in those patients presenting depressive symptoms at the baseline.
Support (if any): None

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INSOMNIA AND METACOGNITIVE ABILITIES: A NEW TREATMENT TARGET?

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Introduction: Metacognition is defined as the ability to reflect on one's mental state. Literature showed that dysfunctional metacognitive activity (such as worry and rumination) plays an important role in insomnia genesis and maintenance. The aim of this study is (i) to evaluate metacognition differences between insomnia disorders (ID) patients and good sleepers (GS)and (ii) to assess Cognitive-Behavioral Therapy for Insomnia (CBT-I) effectiveness on both insomnia and metacognitive abilities.

Methods: We compared 27 GS (Insomnia Severity Index, ISI<10) (63.0% female, mean age 33±13.7yrs) and 27 ID patients (51.9% female, mean age 46.4±13.7yrs) evaluated both by ISI and Metacognition Insomnia Questionnaire (MCQ-I). ID patients underwent 7-session of group CBT-I and were evaluated pre- (T0) and post- (T1) treatment.
Results: GS and ID patients differed in MCQ-I total score (GS=105.6±20.5 vs ID= 138.1±26.2). All ID patients' scores were above the clinical cutoff of 110. ID patients showed significant improvements both at ISI (T0=14.67±4.67 vs T1=7.07±4.37, p<0.001) and Sleep Diary parameters (T0 vs T1, p<0.05) as sleep latency, wake after sleep onset and sleep efficiency at T1. ID patients also showed an improvement of MCQ-I scores at T1, nevertheless, maintaining MCQ-I the mean score above the clinical cutoff level (MCQ-I_T0=138.1±26.2 vs MCQ-I_T1=123.7±28.6; p<0.05). Indeed, 29.6% of ID patients maintained equal or worse MCQ-I score at T1 compared to T0; 63% of ID patients still had a MCQ-I score above the clinical cutoff at T1.
Conclusion: CBT-I results effective on insomnia symptoms. Metacognitive dysfunctions appears to be a core feature in ID patients compared to good sleepers. Although the score reduction was significant after CBT-I, metacognitive dysfunction did not show remission after treatment possibly indicating the need of a specific intervention on this aspect. Metacognitive dysfunction in ID needs to be further investigated and may represent a new treatment target, in order to improve CBT-I effectiveness.
Support (if any): None

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SLEEP HYGIENE COMPLIANCE AND SLEEP IN YOUNG ADULT DRINKERS WITH INSOMNIA: A DAILY ANALYSIS

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Introduction: Empirical evidence linking sleep hygiene practices to subsequent sleep parameters – and the extent to which those compare to evidence-based practices such as stimulus control – is limited. This study examined the daily impact of recommendation compliance on sleep in a sample of young adult drinkers with insomnia.
Methods: Young adults (18-30y; N=56, 75% female) who met diagnostic criteria for insomnia and reported past-month binge drinking wore wrist actigraphy and completed online sleep diaries for 7+ days (492 reports). Diaries assessed compliance with nine sleep hygiene recommendations: to limit naps; limit caffeine; avoid caffeine after 12p; avoid tobacco, alcohol, vigorous exercise, and heavy meals within 2 hours of bedtime; avoid bright light within 30 minutes of bedtime; and utilize a bedtime routine. If participants reported wake after sleep onset, diaries also assessed if they had gotten out of bed and returned to bed only when sleepy (partial stimulus control instructions). Multilevel models examined three outcomes: sleep quality, self-reported sleep efficiency, and actigraphy-measured sleep efficiency (α=.05/3≤.017). Covariates included gender; college enrollment; weekday versus weekend; and between-person differences in insomnia severity, hazardous drinking, and average compliance,
Results: Participants self-reported better sleep efficiency on days that they avoided naps (B=3.64, p=.004; 95% CI=1.20, 6.08). They also self-reported better sleep quality (B=0.40, p<.001; 95% CI=0.19, 0.60) and sleep efficiency (B=3.94, p<.001; 95% CI=1.76; 6.12) on days that they followed stimulus control. Surprisingly, they reported worse sleep quality (B=-0.28, p=.017; 95% CI=-0.51, -0.05) and sleep efficiency (B=-3.74, p=.002; 95% CI=-6.08, -1.40) on days that they avoided alcohol use before bedtime. No variables were significantly associated with actigraphy-based sleep efficiency. At the between-person level, participants reporting more at-risk drinking reported worse sleep quality (B=-0.04, p=.017; 95% CI=-0.08, -0.01).
Conclusion: Data provide empirical support for recommendations that young adult drinkers with insomnia avoid naps and get out of bed during nighttime awakenings. Although heavier drinkers reported worse sleep quality than lighter drinkers, they also reported better subjective (but not objective) sleep on nights they drank close to bedtime. We speculate that this is due to later bedtimes on heavy-drinking nights.
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HISTORICAL USE OF SUBSTANCES FOR INSOMNIA IMPACTS CURRENT BELIEFS ABOUT HYPNOTIC MEDICATIONS

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Introduction: The purpose of the current study was to examine the relationship between current beliefs about hypnotic medications and historical use of prescription hypnotic medications or non-prescription substances for sleep (i.e., over the counter [OTC] medications, alcohol, and cannabis).
Methods: Participants were 142 middle age and older adults with insomnia (M age = 62.9 [SD = 8.1]; 71.1% female) enrolled in the RCT of the Effectiveness of Stepped-Care Sleep Therapy In General Practice (RESTING) study. Participants reported on history of substances they have tried for insomnia and completed the Beliefs about Medications Questionnaire-Specific with two subscales assessing beliefs about 1) the necessity for hypnotics, and 2) concerns about potential adverse consequences of hypnotics. Participants were grouped based on whether they had used no substances for sleep (No Subs, 11.6%), only prescription medications (Rx Only, 9.5%), only non-prescription substances (NonRx Only, 26.6%), or both prescription and non-prescription substances (Both, 52.3%).
Results: Sixty-one percent of the sample had used prescription medication for sleep and 79% had used non-prescription substances (74% OTC medication, 23% alcohol, 34% cannabis). The greater number of historical substances endorsed, the stronger the beliefs about necessity of hypnotics, F(1,140)=23.3, p<.001, but not about concerns. Substance groups differed significantly on necessity beliefs, F(3,1)=10.68, p<.001; post-hocs revealed the Both group had stronger beliefs than the No and NonRx Only groups. Substance groups also differed significantly on the concerns subscale, F(3,1)=6.68, p<.001; post-hocs revealed the NonRx Only group had stronger harm beliefs than the other three groups.
Conclusion: The majority of the sample had used both prescription and non-prescription substances to treat insomnia. Historical use of substances for treating insomnia was associated with current beliefs about hypnotics. Individuals who had used both prescription and non-prescription substances for sleep in the past had stronger beliefs about needing hypnotics to sleep at present, which may reflect a pattern of multiple treatment failures. Individuals who had only tried non-prescription substances for sleep may have specifically sought alternative substances due to concerns about using hypnotics. Future research should seek to understand the impact of treatment history on engagement in and benefit from non-medication-based treatment for insomnia.
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COGNITIVE BEHAVIORAL THERAPY WITH EXERCISE IN ADULTS WITH INSOMNIA AND SHORT SLEEP: DAYTIME FUNCTION OUTCOMES FROM A PILOT STUDY

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Introduction: Cognitive behavioral therapy for insomnia (CBT-I) is efficacious, but there is mixed evidence as to whether improvement is blunted in adults with insomnia and short sleep duration. Exercise training can reduce physiologic hyperarousal and may increase homeostatic sleep drive, which could potentiate CBT-I treatment effects. This pilot study explored changes in self-reported outcomes from a CBT-I intervention augmented by exercise training in a sample of adults with insomnia and objective short sleep duration.
Methods: Eight adults (50% female, 62.5% white) with insomnia disorder and short sleep duration (mean actigraphic TST <6.5 hr) completed a 12-week single-arm trial. Participants self-administered the online "Sleep Healthy Using the Internet" (SHUT-I) CBT-I program with additional staff guidance while completing a supervised exercise program (EX; 150 min/wk of moderate-intensity aerobic exercise and 2 days/wk of strength training). Participants completed assessments of self-reported sleep and daytime function pre- and post-intervention, including the Insomnia Severity Index (ISI), Flinders Fatigue Scale (FFS), Ford Insomnia Response to Stress Test (FIRST), Perceived Stress Scale (PSS), and Epworth Sleepiness Scale (ESS). Differences between timepoints were analyzed using paired t-tests and Cohen's d effect size calculations.
Results: Insomnia severity significantly decreased after the intervention (ISI: $p<0.001$, $d=2.99$), with 75% reporting post-intervention ISI ≤ 7. Likewise, fatigue significantly decreased after the intervention (FFS: $p=0.032$, $d=0.95$). Symptoms of stress-related sleep reactivity and stress were also reduced (FIRST: $p=0.012$, $d=1.19$; PSS: $p=0.014$, $d=1.14$). Though nonsignificant, large reductions in sleepiness were additionally observed (ESS: $p=0.058$, $d=0.80$).
Conclusion: In this pilot trial among patients with insomnia and short sleep duration, online CBT-I plus a supervised exercise program resulted in a significant reduction in insomnia severity. The intervention also produced large and meaningful reductions in fatigue and stress, which are common daytime impairments in patients with insomnia. Future research should attempt to disentangle the independent contributions of CBT-I and exercise on outcomes in this population.
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THOUGHT CONTROL STRATEGIES AND INSOMNIA SEVERITY IN YOUNG-ADULT URBAN RESIDING AFRICAN AMERICANS

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Introduction: Poor sleep is common in our society, particularly for African Americans. Unwanted, intrusive thoughts at bedtime contribute to sleep disturbances, and the nature of intrusive thoughts may be influenced by perception of threat among people living in stressful urban environments. Research has suggested that strategies to control intrusive thoughts vary in their adaptiveness and may be modifiable. These findings need to be confirmed in populations residing in stressful urban environments where perceived threats contribute to intrusive thoughts.The present study attempts to replicate prior research examining the relationship between thought control strategies and insomnia in urban residing young-adult African Americans.
Methods: Sixty-three young-adult African Americans completed the Thought Control Questionnaire for Insomnia-Revised and the Insomnia Severity Index (ISI).
Results: Thought control strategies previously associated with insomnia were significantly correlated with the ISI (aggressive suppression $r=0.51$, $p<0.01$ social avoidance $r=0.32$, $p<.01$, behavioral distraction $r=0.386$, $p<0.01$ and worry $r=0.51$, $p<0.01$). We did not find significant associations between the thought control strategy previously associated with healthy sleep and the ISI (cognitive distraction $r= 0.20$, $p>0.05$). In a grouped comparison between good sleepers and those with insomnia worry was the only subscale that was endorsed significantly greater among those with insomnia ($t(61)=-2.91$, $p<.05$)
Conclusion: These preliminary data replicate prior findings that suggest that aggressive suppression and worry are maladaptive thought control strategies. in a young-adult African American sample. Future research with a larger sample is needed to identify strategies that can improve sleep in this population.
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DCBT-I WITH CHATBOT AND ARTIFICIAL INTELLIGENCE: A FEASIBILITY STUDY IN BRAZIL

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Introduction: Digital cognitive-behavioral therapies for insomnia (dCBT-I) provide low-cost, evidence-based technology, effective in improving mental health and reducing healthcare costs. However, dropout rates still challenge dCBT-I scalability. Moreover, few solutions are available in middle-and-low-income economies where they are most needed. Our goal was to investigate feasibility, describing real-world data and preliminary findings of a novel, fully automated program, developed by Vigilantes do Sono (Sleep Watchers) using Chatbot and Artificial Intelligence (AI).
Methods: A digital coach interacts with users daily for 5–10 minutes, asking them to complete tailored diaries and delivering CBT-I knowledge pills in ~50 sessions, during ~7 weeks. The Insomnia Severity Index (ISI) is used before and after sleep restriction cycles, weekly revised by an algorithm. Participants (18+ years) were recruited (Jan-Oct/2020) through advertisements on social media, organic search, or were referred by health-care professionals, without face-to-face evaluation. All electronically signed an informed consent. We estimated engagement dividing number of complete diaries by number of days in the program. Generalized Estimating Equations (GEE) evaluated changes in sleep parameters, adjusting for baseline characteristics.
Results: Of 3,887 individuals who completed initial assessment, 3,139 (81%) had insomnia (ISI ≥11) and 1,489 (42±11 years, 91% women) fulfilled 7+ diaries, commenced sleep restriction, and were included in analysis. Of them, 604 (41%) completed a second ISI and 326 (22%) finished the program. GEE analyzing 42,802 diaries showed sleep duration increased 16.8 (11.9–21.6) minutes from first to second week and 67.3 (52.8–81.8) after week seven; parallel to a relative increase of 34% in sleep efficiency among women and 26% among men. Of 296 participants who reached therapeutic response (ISI reduction ≥8), 66% completed all sessions and 34% crossed half-way. Insomnia remission (ISI≤7) was seen for 55% and 33% of those with subthreshold (n=171) or clinical (n=419) baseline insomnia, respectively. Median

(interquartile) engagement was 86% (65–98) and 90% of users recommend the program.
Conclusion: Chatbot and AI provide a framework to customize dCBT-I and personalize insomnia therapy, potentially favoring engagement and effectiveness. Our findings demonstrate feasibility of the program and support moving forward to continued development and testing the effects in clinical trials.
Support (if any):

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INSOMNIA TREATMENT PRACTICES OF PRIMARY CARE PROVIDERS IN PRIMARY CARE SETTINGS

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Introduction: Insomnia is highly prevalent in adult populations, with rates found to be between 10% and 40% as reported in a metanalysis conducted by Zhang et al. (2019). Insomnia is associated with worsened health outcomes and increased healthcare utilization. Primary care providers (PCPs) are the first point of contact for most people seeking treatment for insomnia. The American Academy of Sleep Medicine has proposed six quality metrics for the evaluation and treatment of insomnia (Edinger et al., 2015). In this study, we investigate how often primary care providers meet these quality metrics when they encounter a patient with a new complaint of insomnia.
Methods: We reviewed the charts of adult patients seen in our primary care clinic department with a new presenting complaint of insomnia between 2014–2016. The clinic notes were scored to see if any of the six metrics of quality care for insomnia as proposed by the AASM were addressed in the index appointment (T1) and in follow up appointments (T2) within three months.
Results: Demographic variables were analyzed (N=155; 48 males, 107 females); mean age 64 years (range 24–98). We found that PCPs documented the following: at T1, assessment of sleep quality (68%), evidence-based treatment provided (82%), daytime functioning assessed (19%), and adverse side effects assessed (11%). 29% of subjects returned for a follow up visit with 3 months. At T2, there was an assessment of sleep satisfaction/quality (40%), and of improved daytime functioning (87%).
Conclusion: Presently, evaluation and treatment of insomnia by PCPs is not standardized. By identifying how providers address insomnia in practice, we can develop interventions to help promote adherence to the national guidelines for treatment of insomnia in a non-sleep medicine healthcare setting.
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USE OF A CLINICIAN'S GLOBAL IMPRESSION OF SEVERITY SCALE TO MEASURE INSOMNIA SEVERITY IN ALZHEIMER'S DISEASE-DEMENTIA PATIENTS

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Introduction: Full montage polysomnography (PSG) is the gold standard for the objective evaluation of sleep but is time consuming and inaccessible to most clinicians. A Clinician's Global Impression of Severity (CGI-S) scale can be used in clinical practice to provide a subjective assessment of patients' insomnia severity. However, the utility of a CGI-S scale for assessing insomnia in patients with Alzheimer's disease (AD)-dementia is not well understood. In a recent Phase III randomized, placebo-controlled clinical trial (NCT02750306), patients on suvorexant with AD-dementia and insomnia showed improvements in both PSG total sleep time (TST) and CGI-S scores. We conducted additional analyses to examine the association between CGI-S and PSG-TST to inform on the possible use of a CGI-S scale to assess insomnia severity in patients with AD-dementia in real-world settings.
Methods: Patients (N=285) met clinical diagnostic criteria for both probable mild-to-moderate AD-dementia and insomnia. The primary endpoint was change-from-baseline in overnight PSG-TST at Week-4. A single-item CGI-S rating of insomnia with responses of 1 (normal, not ill at all) to 7 (among the most extremely ill patients) was completed by a trained rater at baseline and after 2 and 4 weeks. CGI-S was an exploratory endpoint. Post-hoc correlational analyses and analyses of distribution of change-from-baseline to Week-4 in CGI-S response categories were performed.
Results: Pearson correlation indicated a significant association at baseline between PSG-TST and CGI-S ($r=-0.18$, nominal $p=0.004$). A correlation of change-from-baseline to Week-4 also indicated an association between PSG-TST and CGI-S ($r=-0.24$, nominal $p<.0001$). The distribution of change in CGI-S response category results at Week-4 showed that, compared to placebo, numerically less patients on suvorexant remained stable or worsened by >1 response category (21.8% vs. 29.4%, respectively) and numerically more improved by ≥1 response category (73.3% vs. 67.9%, respectively).
Conclusion: Our findings suggest that a CGI-S scale may be a useful tool for assessing insomnia severity in mild-to-moderate AD-dementia patients. Future studies with these patients are needed to determine the utility of a CGI-S scale in real-world settings.
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DO DEPRESSIVE SYMPTOMS MEDIATE THE ASSOCIATION BETWEEN INSOMNIA AND PHYSICAL ACTIVITY?

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Introduction: Insomnia and depression are highly comorbid and have been shown to be independently associated with lower levels of physical activity. It is not clear, however, if being less physically active is a risk factor for or consequence of depression and insomnia. The factors that explain the associations between insomnia, depression, and physical activity are likely complex and overlapping. For example, insomnia may predict inactivity by impacting one's energy levels, leaving them too tired to exercise. Insomnia may also interfere with one's motivation to exercise due to low mood, as insomnia is associated with the development of depressive symptoms. The purpose of the present study was to explore whether depression mediated the link between insomnia and low levels of physical activity.
Methods: A national online survey was conducted from April-June 2020. Participants completed surveys to assess demographics, mood, sleep, and physical activity. Depressive symptoms were estimated with the Center for Epidemiologic Studies Depression Scale (CES-D). Insomnia symptoms were estimated with the Insomnia Severity Index (ISI). Physical activity levels were estimated with the International Physical Activity Questionnaire (IPAQ). Analyses were conducted using multiple linear regression, with separate models for depression, insomnia, and the combination of the two, on levels of physical activity.
Results: 3,952 adults (Mage = 46.9 years) completed the survey. According to the unadjusted models, greater insomnia symptoms were associated with greater depressive symptoms ($b = 0.4523$,

SE = 0.019593, p < .001), and lower levels of physical activity (b = -38.741, SE = 18.236, p = 0.0337). The relationship between insomnia and physical activity was no longer significant, however, when controlling for depression (b = -6.140, SE = 19.274, p = 0.75). According to the mediation analyses, there was an indirect effect of insomnia on physical activity that was explained by differences in depressive symptoms (Sobel Test = -4.895, SE = 6.518, p < .001).
Conclusion: Our findings support previous research indicating associations between symptoms of insomnia and depression and physical activity. Future research should examine if these same results hold using a longitudinal design.
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THE ROLE OF SELF-ESTEEM AND SLEEP ON INFLAMMATORY MARKERS IN YOUNG ADULTS

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Introduction: Disturbed sleep is common among young adults and is associated with poorer health and developmental outcomes. A large percentage of young adults also struggle with low self-esteem. Together, disturbed sleep and low self-esteem may deplete coping resources, heighten to reactivity to stress, and increase disease risk. Yet no studies to our knowledge have examined interactions between self-esteem and sleep on biomarkers of health among young adults.
Methods: To address this gap, we investigated associations between sleep quality, self-esteem, and two inflammatory markers, C-reactive protein (CRP) and interleukin-6 (IL-6), in a sample of 60 young adults (mean age 25.3 ± 4.0 years old, 53% female, 83% White). Participants completed a baseline survey to assess self-esteem (Rosenberg Self-Esteem Questionnaire) and sleep quality (Pittsburgh Sleep Quality Index [PSQI] sleep quality item), followed by 14 days of self-reported sleep disturbances each morning (PROMISTM sleep disturbances short-form; averaged across the 14 days). A plasma blood draw was then collected to assess CRP and IL-6 approximately one week after the end of the daily portion.
Results: Lower self-esteem (b = -0.04, 95%CI [-0.06,-0.01], p = 0.015) and lower sleep quality were each associated with higher CRP (b = -0.34, 95%CI [-0.62, -0.07], p = 0.015), but not IL-6. Greater daily sleep disturbances were marginally associated with higher CRP (b = 0.37, 95%CI [-0.06,-0.79], p = 0.088]. Interactions between self-esteem and either sleep quality or sleep disturbances did not predict CRP or IL-6.
Conclusion: Our results suggest low self-esteem and poorer sleep are each associated with higher levels of inflammation but may not interact to exacerbate risk. It is possible low self-esteem and poor sleep each lead to negative emotions or engagement in risky behaviors (e.g., substance use, sedentary behavior) that impact levels of inflammatory markers. Overall, our results highlight the importance of assessing both sleep and personality traits in relation to biomarkers of health among young adults.
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EVENING CHRONOTYPE PREDICTS SUBJECTIVE SLEEP SYMPTOM SEVERITY IN PREGNANT WOMEN WITH INSOMNIA DISORDER

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Introduction: Evening chronotype is associated with greater reports of insufficient sleep and sleep-related distress. Little research has examined this relationship within the context of pregnancy. This study investigated whether eveningness predicts insomnia severity, sleep effort, dysfunctional sleep beliefs, and sleep reactivity to stress in pregnant women with insomnia disorder.
Methods: Pregnant women with insomnia disorder who spoke English or Spanish enrolled in a clinical trial of cognitive behavioral therapy for insomnia (N = 178; M age = 32.6 years). Before beginning treatment, participants completed the Composite Scale of Morningness (CSM), Insomnia Severity Index (ISI), Glasgow Sleep Effort Scale (GSS), Dysfunctional Beliefs and Attitudes about Stress Scale (DBAS), and Ford Insomnia Response to Stress Test (FIRST). Participants were categorized into evening, intermediate, or morning chronotypes (bottom 25%, middle 50%, or top 25% of CSM scores, respectively). MANCOVA examined whether chronotype predicted higher baseline ISI, GSS, DBAS, and FIRST scores after adjusting for age, gestational week of pregnancy, and language.
Results: Sleep measures collectively differed by chronotype, F(8, 336) = 4.05, p < .001; Wilk's Λ = .83, partial η-sqd = .09. Follow-up ANOVAs testing individual dependent variables were all significant (partial η-sqd = .04 – .10, p < .05). Pairwise comparisons (Bonferroni-adjusted; p < .05) found that evening types had higher ISI scores than intermediate (M difference = 2.21) and morning types (M difference = 2.30), and higher DBAS scores than morning types (M difference = .95). Morning types had lower FIRST scores than evening (M difference = 5.44) and intermediate types (M difference = 3.89).
Conclusion: Evening chronotype was associated with greater insomnia severity and maladaptive sleep-related cognition than other chronotypes among pregnant women with insomnia disorder. Future research may examine whether differences in chronotype have implications for insomnia treatment outcome during pregnancy, and whether greater morningness confers protection against sleep challenges during the early postpartum period.
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MEASURING DAYTIME SLEEPINESS IN INSOMNIA DISORDER

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Introduction: The EPWORTH Sleepiness Scale (ESS) is correlated with clinical parameters among patients with obstructive sleep apnea. However, its clinical relevance among patients with insomnia disorder is not clear. These patients often do not report daytime sleepiness nor have abnormal MSLT scores, but many do experience sleepiness in the evening. As a result, the ESS may not be the most appropriate measure for assessing daytime sleepiness among insomnia patients. This study aimed to evaluate clinical correlates of ESS among patients with insomnia. It also examined correlates of two items from the PROMIS item bank that specifically probe daytime sleepiness.
Methods: We used baseline data from 141 participants with insomnia disorder (mean age = 63.1y [SD 8.2]; 72% female) in the RESTING study (RCT of the Effectiveness of Stepped-Care Sleep Therapy In General Practice). Clinical measures: the Insomnia Severity Index (ISI), the Geriatric Depression Scale (GDS), and the Morningness Eveningness Questionnaire (MEQ). ESS>10 defined excessive sleepiness. Two PROMIS items assessed frequency of being sleepy and of having trouble staying awake during the day, with ratings of 'quite a bit' and 'very much' classified as excessively sleepy.

Results: The ESS did not correlate with any of the clinical variables (ISI, GDS, MEQ). Correlations with these three variables with the PROMIS Sleepiness were .36, .22, and -.24 and with the PROMIS Excessive Sleepiness .28, .31, and -.17. Of the 38 participants with ESS>10, 80% were not excessively sleepy per PROMIS. PROMIS Excessive Sleepiness classified only 9 participants as excessively sleepy, of which 7 (78%) were not classified by the ESS as excessively sleepy.
Conclusion: These results suggest that the ESS might not be a clinically relevant measure among people with insomnia disorder and that the PROMIS items may better capture sleepiness and excessive sleepiness during the daytime in this patient group. The divergence of the two measures might relate to whether instructions specify daytime as the period assessed, since people with insomnia may be more likely to experience evening, rather than daytime, sleepiness. It might also relate to differences in item wording (i.e., struggling to stay awake [PROMIS] versus likelihood of falling asleep [ESS]).
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CORTICAL THICKNESS MODERATES ASSOCIATION BETWEEN SLEEP ARCHITECTURE AND PAIN IN ADULTS WITH FIBROMYALGIA

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Introduction: Fibromyalgia is associated with chronic widespread pain and insomnia. While sleep and pain are mutually influential, how the cortical thickness (CT) of pain-related brain regions influences that relationship (i.e., sleep architecture and evening/morning pain) is unknown. This study examined how the CT of two regions involved in pain processing - the anterior cingulate cortex (ACC) and insula - influenced the link between sleep architecture and evening vs next morning pain in women with fibromyalgia.
Methods: Thirty adults with fibromyalgia and insomnia (Mage=57.2, SD=13.1) completed overnight polysomnography and daily diaries (14 days) tracking sleep and pain [0–100 (most intense). Pain discrepancy (PD) is the average difference between nighttime and next morning pain (evening - morning). Participants underwent MRI, and FreeSurfer (v5.1.0) estimated CT. Multiple regressions examined CT's influence on the sleep stage [%stage1, %stage2, %stage3, %rapid eye movement (REM)] and PD relationship (controlling for age and education). For significant CT moderation, significance of simple slopes at different CT levels were examined: high (1 SD above), average, and low (1 SD below).
Results: Right rostral ACC (rRACC) CT moderated the relationship between %stage2 (B=-1.41, SE=0.6, p=.03, R^2=0.14), %stage3 (B=2.10, SE=0.97, p=.04, R^2 =0.13), %REM (B=2.35, SE=1.12, p=.04, R^2=0.13) and PD. Greater %stage2 was associated with higher morning vs evening pain at high rRACC thickness (B=-0.67, SE=0.22, p=0.005). Greater %stage3 (B=0.97, SE=0.38, p=0.02) and %REM (B=0.92, SE=0.42, p=0.04) were associated with lower morning pain vs evening pain at high, but not average or low rRACC thickness. Left insula CT moderated the association between increased %stage3 and lower morning vs evening pain (B=2.91, SE=1.18, p=.02, R^2=0.34) at the average and high, but not low thickness levels (B=0.36, SE=0.17, p=0.05; B=1.41, SE=0.48, p=0.008 respectively).
Conclusion: High cortical thickness in the rRACC and average to high L-insula cortical thickness moderated the association between restorative sleep (%stage3, REM) and lower morning vs evening pain. Future studies examining the role of CT in pain-related brain regions on the association of restorative sleep with overnight pain processing are warranted.
Support (if any): National Institute of Nursing Research (NR017168; PI: McCrae). Clinical trial NCT02001077 Sleep and Pain Interventions (SPIN2), University of Missouri (PI: McCrae).

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SLEEP, PAIN, AND COGNITION IN WOMEN WITH CHRONIC WIDESPREAD PAIN AND INSOMNIA

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Introduction: Our team has shown pain interacts with sleep in its association with cognition in cardiac patients and older adults, such that better sleep is associated with better cognitive performance in individuals reporting high pain. Whether these associations exist in the context of chronic pain is unknown. This study examines these associations in women with chronic widespread pain and insomnia (CWPI) and extends our prior findings by including objective/subjective pain measures.
Methods: 43 adult women (Mage=47.30, SD=13.93) with CWPI completed 14 daily diaries measuring wake time after sleep onset-WASO and total sleep time-TST. Daily diaries and thermal application [thermode on foot plantar] assessed subjective pain [0–100(most intense)]. Tender point testing assessed objective pain threshold [force(kg) on 18 tender points until painful]. Participants completed cognition tasks: Stroop (attention/processing speed) and Sternberg (working memory). Multiple regressions evaluated whether sleep (average WASO/TST) interacted with average subjective (diary/thermal ratings) and objective (force) pain in its association with cognition (Stroop reaction time (RT) on congruent trials/Sternberg #correct), controlling for age/education.
Results: WASO interacted with subjective pain (daily-B=.0003, SE=.0001, p=.009; thermal-B=.0002, SE=.004, p=.01) in its association with attention/processing speed. Higher WASO was associated with longer Stroop RT in high pain (~70/100) participants (B=.005, SE=.003, p=.047) and faster RT in low pain (~30/100) participants (B=-.009, SE=.004, p=.03). Higher WASO was associated with longer Stroop RT in those with high (~74/100; B=.01, SE=.002, p=.01), but not average (~46/100) or low (~19/100) thermal pain ratings (ps>.05). TST interacted with daily pain in its association with attention/processing speed (B=.001, SE=.00, p=.005). In participants with high (B=-.003, SE=.001, p=.02), not average (~50/100) or low pain (~30/100, ps>.05), longer TST was associated with faster Stroop RT. In those with low (~1kg, B=.07, SE=.02, p<.001) and average (~2kg, B=.05, SE=.01, p=.002) pain thresholds, longer TST was associated with better Sternberg performance (trending interaction: B=-.03, SE=.02, p=.09).
Conclusion: In CWPI patients with high pain, better sleep was associated with better cognitive performance. These findings suggest sleep may hold potential to mitigate pain's impact on cognition. Future studies should examine whether interventions that target sleep also improve cognition in chronic pain patients with high pain.
Support (if any): NINR(R01NR017168)/ClinicalTrials.gov(NCT02001077), PI McCrae.

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SUBJECTIVE-OBJECTIVE SLEEP DISCREPANCY AND QUALITY OF LIFE IN SELF-REPORTED INSOMNIA AND SLEEP APNEA

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Introduction: Current diagnostic classifications define insomnia based on self-reported sleep difficulties. However, differences between self-reported and objectively measured sleep parameters (subjective-objective sleep discrepancy or sleep misperception) are very common. Insomnia and sleep apnea cause common impairments that overlap and have negative impacts on overall health. Previous studies have encouraged an in-depth understanding of subjective-objective sleep discrepancy to inform a role for behavioral, mind-body approaches to insomnia. In this study, utilizing patients with insomnia and comorbid sleep apnea, we aimed to understand associations between self-reported insomnia, sleep difficulties, sleep misperception and quality-of-life.
Methods: We conducted a secondary analysis using data from the Sleep Heart Health Study (a multi-site nationally representative sample) to examine the profile of subjective and objective sleep measures in people with insomnia (IS, n=73) and comorbid sleep apnea (IS+SA, n=143), compared to individuals with sleep apnea only (SA, n=296) and normal sleep controls (NSC, n=126). We also compared the magnitude of sleep misperception between these four groups and examined the corresponding impact of subjective insomnia complaints on quality-of-life.
Results: Sleep discrepancy was found in all four groups. After controlling for age, sex, mental health conditions, sleep apnea severity, and objectively measured sleep time, the presence of self-reported insomnia had the strongest association with sleep discrepancy on total sleep time (TST, β=-34.4, $p<0.001$) and sleep onset latency (SOL, β=14.7, $p<0.001$). Subjects who reported no difficulty falling asleep slightly underestimated their sleep onset latency, while those who reported difficulty substantially overestimated sleep latency. Self-reported insomnia had a significantly negative impact on the quality of life in both physical and mental components ($p<0.001$).
Conclusion: Sleep discrepancy exists in normal controls, insomnia, and sleep apnea. Subjects with self-reported insomnia have a higher degree of sleep misperception. Both sleep apnea and self-reported insomnia are associated with negative QOL. Those with comorbid sleep apnea report the greatest sleep discrepancy and lowest QOL. Further research is needed to better understand individual profiles of misperception and insomnia phenotypes, apnea comorbidity and quality-of-life. Behavioral, mind-body interventions may offer strategies to address mental stress, sleep misperception, and insomnia.
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AN EXPLORATORY STUDY OF BEDTIME PROCRASTINATION AND EMOTIONAL REGULATION STRATEGIES IN INSOMNIA COMPARED TO HEALTHY INDIVIDUALS

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Introduction: Bedtime Procrastination (BP) is defined as the behavior of voluntarily delaying going to bed, without having external reasons for doing so. Recent research on procrastination behavior suggests that when negative emotions are elevated, procrastination behaviors can be triggered in order to find pleasure to avoid and alleviate them. Procrastination can also occur when there is difficulty regulating emotions. In addition, the reason for bedtime procrastination may be different depending on whether the individuals present with insomnia. According to previous studies, patients with insomnia may exhibit more pronounced negative avoidance of bedtime due to prolonged sleeplessness. Therefore, this study compared the difference between of the bedtime procrastination and the emotional regulation strategies between the insomnia group and the healthy group.
Methods: This study was conducted in 582 adults (mean age 23.06 ±2.16 years), 81.6% females. Individuals scoring higher than 15 on the Insomnia Severity Index (ISI) were classified into the insomnia group (n=375), and those less than 15 were classified into the healthy group (n=207). Participants completed the Bedtime Procrastination Scale (BPS), Emotional Regulation Strategies Checklist. Data was analyzed using descriptive statistics, chi square test, and independent t tests.
Results: The insomnia group had significantly higher bedtime procrastination scores than the healthy group ($t=-6.241$, $p<.001$), and also the avoidant/distractive regulation style score was significantly higher ($t=-1.969$, $p<.05$). In addition, the score of active regulation style was significantly lower in the insomnia group than in the healthy group ($t=3.050$, $p<.01$). There was no significant difference between the two groups in the support-seeking regulation style.
Conclusion: Based on these results, it was confirmed that there was a difference in the bedtime procrastination and the emotional regulation strategies between the insomnia group and the healthy group.
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THE MODERATING EFFECT OF EMOTION REGULATION STRATEGIES IN THE RELATIONSHIP BETWEEN INSOMNIA SEVERITY AND BEDTIME PROCRASTINATION

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Introduction: Bedtime Procrastination (BP) is defined as the behavior of going to bed later than intended, despite the absence of external factors. Bedtime procrastination is also prevalent among insomnia patients, and is associated with various sleep problems. Recent studies suggest emotional regulation as a mechanism of the procrastination behavior that is the conceptual foundation of bedtime procrastination. Emotional regulation difficulties are also associated with insomnia, but there is still a lack of research on the relationship between insomnia, emotional regulation strategies and bedtime procrastination. Thus, the study assumed that severity of insomnia would affect bedtime procrastination, and examined the moderating effect of the emotional regulation strategies in this relationship.
Methods: This study was conducted in 376 adults (mean age 23.73 ±2.14 years, 84.6% females). Participants were asked to answer Bedtime procrastination scale (BPS), an emotional regulation strategy checklist, and the Insomnia severity scale (ISI).
Results: As a result, a significant positive correlation was found between insomnia severity and bedtime procrastination ($r=.286$, $p<.01$), and avoidant/distractive regulation style ($r=.101$, $p<.05$). active regulation style ($r=-.172$, $p<.01$) and support seeking regulation style ($r=-.102$, $p<.01$) showed a significant negative correlation with the severity of insomnia. Bedtime procrastination behavior showed significant negative correlation only with active regulation style ($r=-.151$, $p<.01$). Support seeking regulation style moderated the relationship between

insomnia and bedtime procrastination behavior (B=.0165, 95%, CI=.0014, .0316). The interaction effect between insomnia and support seeking regulation style was also significant (ΔR^2=.0112, p<.05), indicating that the effect of insomnia on bedtime procrastination depends on the level of use of the support seeking regulation style.

Conclusion: These findings suggest that the level of support seeking regulation style is meaningful in terms of how insomnia affects bedtime procrastination.

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FAMILIAL NATURAL SHORT SLEEPERS HAVE GREATER RESILIENCE THAN UNAFFECTED FAMILY MEMBERS

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Introduction: Resilience, a life-long trait, corresponds to the ability to bounce back from adversity. What factors influence resilience is unclear. Here we describe a cohort of individuals with familial natural short sleep (FNSS). Four genes in five families have been identified that confer this trait, DEC2, NPSR1, GRM1 and ADRB1. Individuals in this cohort share a resilience phenotype alongside this decreased sleep need.

Methods: Those reporting less than 6.5 hours of sleep when allowed to sleep ad libitum without any complaints regarding overnight sleep or daytime sleepiness were then interviewed to determine FNSS affected status from 2009 to 2020. Data on mood, depression, sleepiness and resilience were collected from participants and family members enrolled in the FNSS study.

Results: 163 individuals meeting criteria for FNSS were enrolled. Compared to 47 unaffected family members, they had significantly shorter sleep duration as measured by self report and actigraphy, significantly more resilience as measured by the Connor-Davidson Resilience Scale, significantly less sleepiness as measured by the Epworth Sleepiness Scale, and significantly fewer symptoms of depression as measured by the Beck Depression Inventory.

Conclusion: FNSS individuals appear to have a distinct phenotype including shorter sleep duration, greater resilience, less subjective sleepiness, and fewer symptoms of depression. Better understanding the genetics and characteristics of those with familial natural short sleep may provide insight into mechanisms of both restorative sleep and resilience.

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THE ASSOCIATION BETWEEN AROUSALS AND NEUROCHEMICAL BIOMARKERS ACCUMULATION IN OBSTRUCTIVE SLEEP APNEA WITH LOW AROUSAL THRESHOLD

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Introduction: Previous studies indicated the accumulation of neurodegenerative protein may be caused by higher Obstructive sleep apnea syndrome (OSAS) severity. However, the association between arousal-related parameters induced by OSAS and the amyloid burden remains unclear. The aim of this study is to investigate the association between arousal threshold (ArTH) and neurochemical protein accumulation in OSAS patients.
Methods: Suspected OSAS participants were performed Mini-mental status examination (MMSE) and full-night polysomnography (PSG) in the sleep center of Taipei Medical University Shuang Ho Hospital, Taiwan. On the same morning, the blood samples were obtained from the participants. The concentrations of total Tau (T-Tau) and amyloid beta peptide 42 (Aβ42) were quantified by ultra-sensitive immunomagnetic reduction assays. An overall of 23 participants were enrolled and classified into Low ArTH group (n=12) and High ArTH group (n=11) based on low ArTH criteria. Regarding the statistical methods, for categorical variables and continuous variables, Fisher's exact test and Mann-Whitney U test were performed to investigate the differences between groups, respectively. The associations between biomarkers concentrations and PSG parameters were assessed by Spearman's correlation.
Results: Regarding the demographic characteristics in two subgroups, significantly lower body-mass index and OSAS severity were noted in Low ArTH group ($p<0.05$). The MMSE was in normal range in both groups and had no significant differences in subgroups. For PSG parameters, there were significantly lower desaturation index, AHI and higher spontaneous arousals index in each sleep stage in Low ArTH group ($p<0.01$). Nevertheless, in the plasma neurochemical biomarkers, Aβ42 and Aβ42 X T-Tau were significantly higher in Low ArTH group ($p<0.05$). Moreover, in Low ArTH group, T-Tau was positively correlated with respiratory arousals index ($r=0.61$, $p<0.05$) and all arousals index ($r=0.76$, $p<0.01$), respectively. The positive correlations between Aβ42 X T-Tau and respiratory arousals index ($r=0.62$, $p<0.05$), all arousals index ($r=0.75$, $p<0.01$) could also be observed. There were no significant correlations noted in High ArTH group.
Conclusion: OSAS patients with low ArTH have higher neurochemical biomarker levels. Also, the significantly positive correlations between arousals and biomarkers were observed in that group.
Support (if any):

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RISK OF OBSTRUCTIVE SLEEP APNEA: A COMPARISON BETWEEN ISCHEMIC AND HEMORRHAGIC STROKE

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Introduction: Obstructive Sleep Apnea (OSA) is common amongst stroke patients. Distinction between the prevalent types of stroke when evaluating sleep may prove useful to prevent recurrent strokes. There is a lack of information on how apnea prevalence following ischemic stroke compares to hemorrhagic stroke, particularly during the chronic period. Here we set out to retrospectively determine if apnea incidence was more marked in ischemic stroke patients compared to those that received a hemorrhagic stroke diagnose; while taking in account medications taken during the sleep evaluation.
Methods: Medical records were reviewed from 103 patients diagnosed with stroke that underwent a type I fully attended overnight polysomnography. Diagnosis of embolic, thromboembolic or hemorrhagic stroke was obtained from a neurological report that was typically confirmed by computed tomography or magnetic resonance imaging. Medications that the subject was taking at the time of the sleep study were documented by the sleep technologist.
Results: Arousals and microarousal index was higher in the ischemic group ($p<0.005$). Age adjusted assessment of apnea and hypopnea events, indicated that subjects with an ischemic stroke had a higher incidence of apnea and hypopnea compared to the hemorrhagic group ($p<0.005$). Ischemic subjects were also more likely to present severe apnea (AHI > 30) ($p<0.005$). In comparison, a higher percentage of hemorrhagic subjects had an AHI below 5 ($p<0.005$). Type of hemorrhagic stroke did not have an impact on apnea/hypopnea variables. Those with an ischemic stroke were taking significantly more lipid lowering agents ($p<0.05$). Logistic regression analysis indicated that the predictive probability of apnea (AHI > 5) increased from 0.55 to 0.81 ($p < 0.05$) when anti-hypertensive use was considered. An increase in predictive values for apnea was observed for indicators of diabetes such as use of anti-diabetics with or without consideration of diabetic history ($p < 0.05$).
Conclusion: Data suggests that ischemic patients present a higher artherosclerotic load that may contribute to the higher incidence of severe OSA. These data indicate that it is relevant to consider stroke type when determining the risk of OSA thus facilitating new strategies for stroke recurrence prevention.
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UPPER AIRWAY RESISTANCE SYNDROME IS ASSOCIATED WITH HIGH CYCLIC ALTERNATING PATTERN

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Introduction: Upper Airway Resistance Syndrome (UARS) is suspected in individuals with excessive daytime sleepiness, fatigue, and sleep fragmentation associated with increased respiratory effort. UARS can negatively impact daytime function. Conventional polysomnography parameters do not demonstrate significant abnormalities in UARS patients but increase in RERAs and arousal index. Cyclic alternating pattern (CAP) is a periodic electroencephalogram

activity of non-REM sleep that expresses a condition of sleep instability. The objective of the study was to compare CAP components between UARS patients and health individuals.
Methods: Fifteen subjects with UARS and 15 age- and sex- matched controls had their sleep study blinded analyzed. UARS criteria were the presence of sleepiness (Epworth Sleepiness Scale – ESS - ≥ 10) and/or fatigue (Modified Fatigue Impact Scale ≥ 38) associated with an apnea/hypopnea index (AHI) ≤ 5 and a respiratory disturbance index (RDI) > 5 events/hour of sleep, and/or flow limitation in more than 30% of total sleep time. Control group criteria were AHI < 5 events/hour, RDI ≤ 5 events/hour and < 30% of TST with flow limitation and ESS < 10, without sleep, clinical, neurological, or psychiatric disorder. CAP electroencephalogram of both groups was analyzed.
Results: We found higher CAP rate ($p = 0.05$) and CAP index in N1 stage ($p < 0.001$) and in N3 stage ($p < 0.001$) in UARS patients compared to control group. Considering only CAP phase A1 analysis, UARS patients presented higher CAP rate ($p = 0.05$) and CAP index in N1 stage ($p < 0.001$) as well as CAP index in N3 stage ($p < 0.001$) compared to control group. Considering only CAP phase A2 analysis, UARS patients also presented higher number of CAP in N1 stage ($p = 0.05$). There was no significant difference for CAP phase A3 between groups.
Conclusion: Although UARS is associated with high arousal index, we found increase in CAP phase A1 and A2, which do not include necessarily AASM arousals, suggesting not only sleep fragmentation but also sleep instability.
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EFFECT OF OBSTRUCTIVE SLEEP APNEA SEVERITY, SLEEP STAGE AND POSITION ON PATTERNS OF OXIMETRIC DESATURATIONS AND RESATURATIONS

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Introduction: Obstructive sleep apnea (OSA) severity based upon the apnea-hypopnea index (AHI) ignores many characteristics such as the duration of apnea-hypopneas, the duration and degree of oxygen desaturations (SpO2) etc. While hypoxemic burden has received increased attention given its relationship with cardiovascular outcomes, the role of oximetric resaturation vs. desaturation times is not understood. Resaturation times tend to be constant in contrast to desaturation durations. This study was done to assess desaturation and resaturation indices in patients with different OSA severity in differing sleep stages and positions.
Methods: Oximetric desaturation and resaturation slopes were calculated in patients with different OSA severities as rate of change in oxygen saturations (ΔSpO2/Δtime).
Results: 33 patients with OSA were studied (11 in each OSA severity group). Mean desaturation duration was 20.12 ±1.10 seconds with shorter NREM desaturation times (mean 19.07 ±1.11 seconds) as compared to REM desaturation durations (mean 26.66 ±2.69 seconds) (p-value 0.009). Non-supine and supine mean desaturation durations were similar (19.59 ±1.77 and 18.73 ±1.18 seconds respectively). Mean resaturation durations were shorter than desaturation durations at 12.46 ±0.84 seconds and was significantly lower in NREM sleep than in REM sleep (9.32 ±0.41 seconds vs 12.50 ±0.75 seconds p-value 0.002). Resaturation slopes (0.44 %/second (±0.028 %/second)) were steeper as compared to desaturation slopes (-0.26 %/second (±0.02 %/second)) without significant difference between NREM vs. REM desaturation or resaturation slopes. While desaturation slopes were not affected by sleep position, resaturation slopes were significantly steeper in supine compared to non-supine sleep (p-value 0.0046). Desaturation durations increased with OSA severity, but resaturation times decreased (resaturation slopes became steeper) with significant differences between patients with different OSA severity.
Conclusion: This study demonstrated that oxygen resaturation slopes varied according to different OSA severity and sleep position. Given that faster resaturation rates may reflect the possibility of higher degrees of reoxygenation-related oxidative stress, this should be assessed as a novel index to predicate OSA outcomes.
Support (if any):

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COMPARISON OF OXYGENATION ABNORMALITIES BETWEEN OBSTRUCTIVE SLEEP APNEA AND CENTRAL SLEEP APNEA

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Introduction: The apnea-hypopnea index (AHI) is used as a generic index to quantify both central sleep apnea (CSA) and obstructive sleep apnea (OSA) syndromes. Patterns of oxygenation abnormalities seen in CSA and OSA may be key to understanding differing clinical impacts of these disorders. Oxygen desaturation and resaturation slopes and durations in OSA and CSA were compared between OSA and CSA patients.
Methods: Polysomnographic data of patients aged 18 years or older with diagnosis of OSA and CSA, at University of Iowa Hospitals and Clinics, were analyzed and demographic data were collected. Oximetric changes during hypopneas and apneas were studied for desaturation/resaturation durations and desaturation/resaturation slopes. Desaturation and resaturation slopes were calculated as rate of change in oxygen saturation (ΔSpO2/Δtime). Comparison of hypoxemia-based parameters between patients with OSA and CSA was performed using unpaired t-test.
Results: 32 patients with OSA with median AHI of 15.4 (IQR 5.1 to 30.55) and median ODI of 15.47 (IQR 9.50 to 29.33) were compared to 15 patients with CSA with a median AHI of 20.4 (IQR 12.6 to 47.8) and median ODI of 27.56 (IQR 17.99 to 29.57). The mean number of desaturation and resaturation events was not significantly different between patients with OSA and CSA (OSA - 106.81±87.93; CSA - 130.67±76.88 with a p-value 0.1472). 4/15 CSA patients had Cheyne-Stokes breathing, 2/15 had treatment emergent central sleep apnea, 1/15 had methadone-associated CSA and for 8/15, no etiologies for CSA were found. Mean desaturation durations was significantly longer in OSA (20.84 s ± 5.67) compared to CSA (15.94 s ± 4.54) (p=0.0053) and consequently the desaturation slopes were steeper in CSA than OSA (-0.35%/sec ±0.180 vs. -0.243 ± 0.073; p=0.0064). The resaturation duration was not significantly longer in OSA (9.76 s ± 2.02) than CSA (9.057 s ± 2.17) (p=0.2857). Differences between desaturation duration and slopes between CSA and OSA persisted during REM and NREM sleep, and in supine sleep.
Conclusion: As compared to OSA, patients with CSA have different patterns of desaturations and resaturations with lesser hypoxic burden with CSA. This may have implications on the clinical outcomes seen between these two disorders.
Support (if any):

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A CONVOLUTIONAL NEURAL NETWORKS MODEL FOR THE DETECTION OF CORTICAL AROUSALS FROM HEART RATE

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Introduction: Cortical arousals are transient events of disturbed sleep that occur frequently in sleep disordered breathing (SDB) and can be used as an indicator of sleep quality. While cortical arousals are typically scored from the electroencephalogram (EEG), arousals are associated with increased sympathetic activity and could therefore be detected from measures of sympathetic activity such as heart rate. Most home sleep test and consumer wearable devices enable continuous recording of heart rate via the electrocardiogram (ECG) or optical heart rate sensors without the inconvenience of EEG electrodes. In this preliminary study, we developed a deep learning-based convolutional neural networks (CNN) model to detect arousals from heart rate.
Methods: This study included 1,083 polysomnograms (PSGs) from five independent studies (Tucson Children's Assessment of Sleep Apnea, Mechanisms of Pharyngeal Collapse in Sleep Apnea, Impact of the Arousal Threshold in Obstructive Sleep Apnea, Predicting Successful Sleep Apnea Treatment with Acetazolamide in Heart Failure Patients, Combination Therapy for the Treatment of Obstructive Sleep Apnea) that were scored for arousals according to American Academy of Sleep Medicine scoring rules. These studies included PSGs from both children and adults (ages 6 and above), with most data coming from participants with evidence or diagnosis of SDB. We used the Pan-Tomkins algorithm to detect R-peaks from the raw ECG signal, transformed the peaks into normalized instantaneous heart rate at 1 Hz frequency, and produced arousal probability in 1-second resolution using a simple CNN model. Due to slight asynchrony between the appearance of arousals in the EEG versus the heart rate, all overlaps between model-predicted arousals and manually scored arousals were considered true-positives.
Results: We evaluated the model on a validation set (n=216). The model achieved a gross area under precision-recall curve score of 0.67 and a gross area under receiver operating characteristics curve of 0.91 Correlation between the number of model-detected and manually scored arousal events was r=0.76.
Conclusion: This preliminary study demonstrates that a deep learning approach has the potential to accurately detect arousals in home sleep tests and consumer wearable devices that measure heart rate.
Support (if any): The study was supported by grant #207-SR-19 from the American Academy of Sleep Medicine Foundation.

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EXERCISE CAPACITY IS MAINTAINED IN OLDER MILITARY PERSONNEL WITH MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA

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Introduction: The relationship between moderate to severe OSA and exercise capacity remains unclear. Prior studies showing a reduction in VO2 max in this population have mostly involved middle-aged and overweight patients. We looked to determine if this trend in VO2 max was present in a similarly aged population of military personnel with previously undiagnosed moderate to severe OSA.
Methods: We studied 170 middle-aged male military members who underwent cardiopulmonary exercise testing (CPET) and polysomnography (PSG) as a part of a comprehensive evaluation for an established military program. For analysis, patients were categorized either into an OSA group (apnea-hypopnea index (AHI) ≥ 15 events/h) or control group (AHI < 15 events/h). VO2 max was compared between groups.
Results: Mean AHI was 29.0 in the OSA group (n =58) versus 7.4 in the controls (n = 112). Patients were of similar age (53.1 vs. 53.7 years) and BMI was slightly higher in the OSA group (27.5kg/m2 versus 26.3 kg/m2, P = .0077). Percent-predicted VO2 max was supernormal in both groups, though was comparatively lower in the OSA group (117% vs. 125%; P <.001). There was a trend toward a blunted heart rate response to exercise in the OSA group as represented by peak heart rate (163 vs. 178; p=0.07).
Conclusion: Older military personnel with moderate to severe OSA have normal exercise capacity. This may suggest that the low-arousal OSA phenotype often noted in military personnel does not significantly influence exercise capacity or that regular exercise helps limit its impact. It remains likely that the effect of untreated OSA on exercise capacity is influenced by several variables including age, BMI, OSA phenotype, and regularity of exercise. Trends in VO2 max and peak heart rate noted in this study may suggest that untreated OSA in certain populations can negatively impact exercise capacity
Support (if any): No external funding

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ETHNICITY MODIFIES THE ASSOCIATION BETWEEN CENTRAL SLEEP APNEA AND ATRIAL FIBRILLATION IN OLDER MEN: KUAKINI HAAS AND MR.OS

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Introduction: Several studies indicated there is an association between central sleep apnea (CSA) and atrial fibrillation (AF) in older populations. However, few studies assessed the impact of ethnicity on the association. We assessed the hypothesis that ethnicity modifies the association between CSA and AF in older men.
Methods: We did a cross-sectional analysis using two population studies of Japanese-American (JA) and White-American (WA) men. The Kuakini Honolulu-Asia Aging Study (HAAS) is a longitudinal cohort study of JA men living in Hawaii. Sleep data were collected between 1999–2000. The Osteoporotic Fractures in Men (Mr.OS) Sleep Study was conducted between 2003–2005 on the continental U.S. The majority of Mr.OS participants were WA. We selected 79–90 year old males, who had overnight polysomnography from both studies. Total participants were 690 JA and 871 WA men. Obstructive apnea-hypopnea index (OAHI) was the measure of the number of obstructive apneas and hypopneas with >4% oxygen desaturation. Additionally, the central apnea index (CAI) was the measure of the number of central apneas. Obstructive sleep apnea (OSA) was categorized as none (OAHI <5), mild (OAHI 5–14), moderate (OAHI 15–29), and severe (OAHI>=30). CSA was defined by CAI>=5. Cheyne-Stokes breathing (CSB) was defined as a minimum consecutive 5–10 minute period of a crescendo-decrescendo respiratory pattern associated with CSA. A board-certified physician confirmed AF by single lead electrocardiography of polysomnography.

Results: The prevalence of AF was 5.7% in JA and 9.1% in WA. The prevalence of CSA and CSB in WA were higher than in JA (11.5% vs 6.5% and 5.7% vs 3.3%, respectively). Conversely, the prevalence of severe OSA in JA (20.7%) was higher than in WA (11.8%). In multivariable-adjusted logistic regression models, CSA was associated with higher odds of AF, and the association was stronger in JA [Odds Ratio (OR)=4.77, 95% confidence interval (CI): 1.95–11.64] than in WA (OR=2.05, 95% CI: 1.07–3.94). CSB showed similar trends as CSA. In contrast, the severity of OSA was not significantly associated with AF in either ethnicity.
Conclusion: Ethnicity modifies the association between CSA and AF. In older JA and WA men, screening for CSA might be important to prevent AF.
Support (if any):

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HEALTH INSURANCE STATUS IN SUBJECTS AT HIGH RISK FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Undiagnosed obstructive sleep apnea (OSA) is a major public health problem. Undiagnosed OSA can result in decreased productivity due to absenteeism, increased risk of comorbidities (cardiovascular disease, diabetes, and depression), and increased motor vehicle as well as workplace accidents. Lack of health insurance coverage can lead to undiagnosed and therefore untreated OSA. The objective of this study is to evaluate health insurance status in subjects at high-risk for OSA.
Methods: This is a cross-sectional, population-based study of adults 18 years and older who participated in the 2017–2018 National Health and Nutrition Examination Survey (NHANES). A modified STOP-Bang score was used to calculate OSA risk. This score included all the variables from the standard STOP-Bang questionnaire, except neck circumference, since it was not reported in the NHANES survey. Subjects were divided into two groups: those at low-risk for OSA with a modified STOP-Bang score of ≤ 3 and those at high-risk for OSA with a modified STOP-Bang score of >4.
Results: A total of 4,847 adult subjects were included, which represented 223,385,241 of the U.S. non-institutionalized population. Using the modified STOP-Bang score cutoff of >4, 20.9% of the sample were classified as high-risk for OSA, while 79.1% were classified as low-risk for OSA. 90% of the high-risk OSA group and 85.1% of the low-risk OSA group reported having health insurance. Sociodemographic data will also be analyzed and included.
Conclusion: Approximately 10% of subjects who are at high-risk for OSA reported not having health insurance. This represents over 4.6 million Americans in the non-institutionalized population. Health insurance can improve access to health care. Timely diagnosis and treatment of OSA not only can reduce morbidity and mortality, but can also reduce health care costs.
Support (if any): CDC for NHANES Data.

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AGREEMENT AND RELIABILITY OF A NEW RESPIRATORY EVENT AND AROUSAL DETECTION ALGORITHM AGAINST MULTIPLE HUMAN SCORERS

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Introduction: Scoring algorithms have the potential to increase polysomnography (PSG) scoring efficiency while also ensuring consistency and reproducibility. We sought to validate an updated event detection algorithm (Somnolyzer; Philips, Monroeville PA USA) against manual scoring, by analyzing a dataset we have previously used to report scoring variability across nine center-members of the Sleep Apnea Global Interdisciplinary Consortium (SAGIC).
Methods: Fifteen PSGs collected at a single sleep clinic were scored independently by technologists at nine SAGIC centers located in six countries, and auto-scored with the algorithm. Arousals, apneas, and hypopneas were identified according to the American Academy of Sleep Medicine recommended criteria. We calculated the intraclass correlation coefficient (ICC) and performed a Bland-Altman analysis comparing the average manual- and auto-scored apnea-hypopnea index (AHI), arousal index (ArI), apneas, obstructive apneas, central apneas, mixed apneas, and hypopneas. We hypothesized that the values from auto-scoring would show good agreement and reliability when compared to the average across manual scorers.
Results: Participants contributing to the original dataset had a mean (SD) age of 47 (12) years, AHI of 24.7 (18.2) events/hour, and 80% were male. The ICCs (95% confidence interval) between average manual- and auto-scoring were almost perfect (ICC=0.80–1.00) for AHI [0.989 (0.968, 0.996)], ArI [0.897 (0.729, 0.964)], hypopneas [0.992 (0.978, 0.997)], total apneas [0.973 (0.924, 0.991)], and obstructive apneas [0.919 (0.781, 0.972)], and moderately reliable (ICC=0.40–0.60] for central [0.537 (0.069, 0.815)] and mixed [0.502 (0.021, 0.798)] apneas. Similarly, Bland-Altman analyses supported good agreement for event detection between techniques, with a mean difference (limits of agreement) of only 1.45 (-3.22, 6.12) events/hour for AHI, total apneas 5.2 (-23.9, 34.3), obstructive apneas 1.8 (-45.9, 49.5), central apneas 1.8 (-9.7, 13.4), mixed apneas 1.6 (-14.8, 17.9), and hypopneas 4.3 (-12.4, 20.9).
Conclusion: Results support almost perfect reliability between auto-scoring and manual scoring of AHI, ArI, hypopneas, total apneas, and obstructive apneas, as well as moderate reliability for central and mixed apneas. There was good agreement between methods, with small mean differences; wider limits of agreement for specific type of apneas did not affect accuracy of the overall AHI. Thus, the auto-scoring algorithm appears reliable for event detection.
Support (if any): Philips

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USING MACHINE LEARNING TO INFORM EXTRACTION OF CLINICAL DATA FROM SLEEP STUDY REPORTS

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Introduction: In-laboratory and home sleep studies are important tools for diagnosing sleep disorders. However, a limited amount of measurements is used to inform disease severity and only specific measures, if any, are stored as structured fields into electronic health records (EHR). We propose a sleep study data extraction approach based on supervised machine learning to facilitate the development of specialized format-specific parsers for large-scale automated sleep data extraction.
Methods: Using retrospective data from the Penn Medicine Sleep Center, we identified 64,100 sleep study reports stored in Microsoft Word documents of varying formats, recorded from 2001–2018. A random sample of 200 reports was selected for manual annotation of formats (e.g., layout) and type (e.g. baseline, split-night, home sleep apnea tests). Using text mining tools, we extracted 71 document property features (e.g., section dimensions, paragraph and table elements,

regular expression matches). We identified 14 different formats and 7 study types. We used these manual annotations as multiclass outcomes in a random forest classifier to evaluate prediction of sleep study format and type using document property features. Out-of-bag (OOB) error rates and multiclass area under the receiver operating curve (mAUC) were estimated to evaluate training and testing performance of each model.

Results: We successfully predicted sleep study format and type using random forest classifiers. Training OOB error rate was 5.6% for study format and 8.1% for study type. When evaluating these models in independent testing data, the mAUC for classification of study format was 0.85 and for study type was 1.00. When applied to the large universe of diagnostic sleep study reports, we successfully extracted hundreds of discrete fields in 38,252 reports representing 33,696 unique patients.

Conclusion: We accurately classified a sample of sleep study reports according to their format and type, using a random forest multiclass classification method. This informed the development and successful deployment of custom data extraction tools for sleep study reports. The ability to leverage these data can improve understanding of sleep disorders in the clinical setting and facilitate implementation of large-scale research studies within the EHR.

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UTILITY OF THE STOP QUESTIONNAIRE IN PREDICTING SLEEP DISORDERED BREATHING IN OLDER WOMEN VETERANS

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Introduction: Sleep disordered breathing (SDB) is underdiagnosed in older women, despite a significant increase in SDB prevalence post-menopause. Few studies have assessed the diagnostic accuracy of SDB screening questionnaires in older women, particularly older Women Veterans (WV). WV have higher rates of SDB compared to non-Veteran women and are particularly vulnerable to sleep disorders in general. We examined the diagnostic accuracy of the STOP questionnaire compared to home sleep apnea testing (HSAT) that includes sleep time estimation (i.e., WatchPAT) in older WV.

Methods: Cross-sectional baseline data obtained from chart review were combined from two behavioral sleep intervention studies targeting WV with sleep difficulties (i.e., insomnia symptoms) or SDB risk factors (e.g., hypertension, obesity). A total of 136 older WV (50-91y; age=60.0±7.8y) completed the STOP questionnaire (yes/no: snoring, tiredness, observed breathing pauses, and high blood pressure [BP]) and had an apnea-hypopnea index (AHI) available from their baseline HSAT (WatchPAT). Sensitivity, specificity, and positive and negative likelihood ratios (+LR/-LR) were calculated to characterize the diagnostic accuracy of STOP≥2 for AHI≥5 (mild SDB) or AHI≥15 (moderate SDB).

Results: 70.6% (n=96) of participants endorsed a STOP≥2, 83.8% (n=114) demonstrated an AHI≥5 and 46.3% (n=63) demonstrated an AHI≥15. For AHI≥5, sensitivity was 73.7% (95% CI=64.6,81.5%), specificity was 45.5% (95% CI=24.4,67.8%), +LR was 1.35 (95% CI=0.91, 2.01), and -LR was 0.58 (95% CI=0.33,1.00). For AHI≥15, sensitivity was 76.2% (95% CI=63.8,86%), specificity was 34.2% (95% CI=23.5,46.3%), +LR was 1.16 (95% CI=0.93,1.44), and -LR was 0.70 (95% CI=0.30,1.20).

Conclusion: The likelihood ratios for STOP≥2 limited the utility of the STOP vs. an HSAT system with sleep scoring in determining AHI. While the STOP correctly identified 3/4 of older WV with SDB on WatchPAT, it correctly identified <50% of older WV without SDB. Screening measures that better capture predictors of moderate SDB in women at risk for SDB are needed, especially in older women who may not present clinically with the common SDB symptoms (i.e. snoring, tiredness, observed breathing pauses, and high BP). STOP compared to polysomnography studies are also needed.

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CLINICAL PHENOTYPES OF OBSTRUCTIVE SLEEP APNEA IN WORLD TRADE CENTER RESPONDERS

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Introduction: The heterogeneity of symptoms in obstructive sleep apnea (OSA) patients has been recently formalized into 3 distinct clusters: Sleepy, Disturbed Sleep, and Minimally Symptomatic. Our previous data showed that OSA is highly prevalent (>75%) in World Trade Center (WTC) responders, and positive airway pressure (PAP) treatment adherence is very poor (<20%). To better understand the heterogeneity of OSA in the WTC cohort, here we sought to examine the distribution of these distinct clinical phenotypes.

Methods: 643 subjects with no history of OSA or reported loud and frequent snoring before 9/11/2001 from the WTC health program clinical centers at Rutgers RWJMS, New Jersey, NYU School of Medicine, and Icahn School Medicine at Mount Sinai, New York underwent 2 nights of home sleep testing using the ARES unicorder (SleepMed, Inc., West Palm Beach, FL, USA). Epworth Sleepiness Scale (ESS), sleep onset insomnia, and sleep maintenance insomnia were assessed with questionnaires. OSA was defined as (AHI4%>=5 or RDI>=15/hr). The three clusters were defined as 1) Sleepy (ESS>10 and/or sleep onset/maintenance insomnia); 2) Disturbed Sleep (not sleepy (ESS<=10) and sleep onset/maintenance insomnia); and 3) Minimally Symptomatic (not sleepy (ESS<=10) and no sleep onset/maintenance insomnia). Distribution of clusters in the WTC cohort was compared to published data from the Sleep Apnea Global Interdisciplinary Consortium (SAGIC) and the Hispanic Community Health Study/Study of Latinos (HCHS/SOL).

Results: Among the subjects diagnosed with OSA (N 440; AHI4%=13(15); RDI =28(19); median(iqr); 81% men; age, 33–87 years; BMI, 27.4±3.7 kg/m2), the distribution of clinical phenotypes was 31.4% sleepy, 48.9% disturbed sleep, and 19.7% minimally symptomatic, and did not differ between OSA severity groups. In comparison to SAGIC and HCHS/SOL, the WTC cohort exhibited significantly increased prevalence of the disturbed sleep phenotype (WTC vs SAGIC: 48.9% vs. 19.8%, $\square 2=54.9$; $p<0.001$; WTC vs. HCHS/SOL: 48.9% vs. 38.1%, $\square 2=26.1$, $p<0.001$).

Conclusion: The predominant clinical phenotype of OSA in the WTC cohort is disturbed sleep (insomnia) and its prevalence is significantly greater than what has been observed in other large OSA cohorts. These findings may help explain the poor adherence to PAP treatment observed in the WTC cohort.

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A WIRELESS PATCH-BASED POLYSOMNOGRAPHY SYSTEM FOR SLEEP STUDIES: EFFECT OF THE 2016 AASM RULES ON AHI IN NORMAL INDIVIDUALS

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Introduction: Current home sleep test (HST) devices are limited by an absence of EEG, or by being too cumbersome to use. We developed a wireless PSG system (Onera Health, NL) consisting of four disposable patches to record EEG, EOG, EMG, SaO2, ECG, bioimpedance derived respiratory airflow and effort, airflow via nasal cannula, snoring sounds, body position, actigraphy, and leg movements. Signals are stored on reusable electronic modules attached to each patch.
Methods: We measured PSG hook-up time in 15 healthy laypersons (6 male, 9 female, age 18-to-70 yrs, BMI 29.7±5.2 kg/m2). We also enrolled 6 additional asymptomatic healthy volunteers (2 male, 4 female, age 27-to-33 yrs, BMI 24.3±5.7 kg/m2) with history of occasional snoring, on which we scored the apnea-hypopnea index (AHI) using data from our patch-based PSG system recorded at home. We evaluated scoring using the 2016 AASM rules for hypopneas in comparison to the 2007 AASM rules requiring a greater than 3% fall in SaO2 for obstructive hypopneas.
Results: Mean hook-up time for applying all four patches and electronic modules was 4:42 ± 1:20 min. Mean home sleep efficiency was 89.5 SE 1.9% with an average REM% of 20 SE 6.7%. When comparing the 2016 vs 2007 AASM rules for scoring hypopneas, the AHI increased more than threefold during NREM (9.0 SE 2.0/h vs 2.7 SE 0.8/h; $p<0.03$) and minimally during REM (11.7 SE 2.3/h and 7.1/h SE 1.8/h; $p<0.01$), implying an overall increase in the AHI from 3.7 SE 0.8/h to 9.9 SE 1.9/h; $p<0.02$. One subject changed AHI category from normal to mild (3.6 to 14.4/h), another from mild to moderate (12.7 to 26.3/h) using the 2016 AASM rules.
Conclusion: Our wireless patch-based PSG system is an easy solution for sleep studies at home or in the sleep lab, lowering the burden to conduct large scale epidemiologic sleep studies. The presence of standard EEG signals allows to determine NREM and REM statistics, respiratory and non-respiratory arousal indices, AHI and RERA's by sleep stages. Preliminary study results show that using cortical arousal criteria for hypopneas, the AHI increase is more pronounced in NREM compared to REM sleep.
Support (if any):

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COMPARATIVE STUDY OF WIRELESS SENSORS VERSUS TYPE III HOME SLEEP APNEA TEST FOR HOME-BASED DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA

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Introduction: More than 22 million Americans are estimated to have obstructive sleep apnea (OSA), though this disease remains perpetually underdiagnosed. Undiagnosed OSA contributes to poor clinical outcomes, large healthcare costs and an economic burden in excess of $150 billion dollars annually. While polysomnography (PSG) is considered the gold standard to diagnose OSA home sleep apnea testing (HSAT) is now used for most patient cohorts. Wireless sensors may offer a lower cost and less burdensome approach to home testing than traditional HSAT.
Methods: We performed a fully remote, national, single-arm, open-label, prospective clinical study to evaluate the performance of a wireless, two sensor experimental system (ANNETM One, Sibel Health) against a Type III HST system. A total of 154 individuals completed screening with 62 screening in as high risk for OSA using the STOP-BANG questionnaire. Ultimately 60 participants were enrolled, and 46 completed a successful home testing night wearing both the commercially available HSAT (Philips Alice NightOne Home Sleep, Koninklijke Philips N.V) and the wireless experimental system. A board-certified sleep medicine physician determined the apnea-hypopnea index (AHI) for the HSAT defined by American Academy of Sleep Medicine v2.6 guidelines. Two study investigators, blinded to the HSAT results, scored the experimental system to determine AHI based on similar guidelines. An independent study investigator conducted the final analysis of comparative performance. Participants completed a psychometric survey of their preferences, experience, and usability of the two testing systems.
Results: We demonstrated a high level of agreement between the HSAT and experimental system for AHI ($r2=0.81$, $p<0.0001$). The sensitivity and specificity of the experimental system to diagnose moderate and severe OSA (AHI>15) was 85% and 95%, respectively. The experimental system had a significantly higher Systems Usability Scale score compared to HSAT (61 vs 48, $p<0.0001$) and more than 85% of participants preferred the experimental system.
Conclusion: This study provides compelling evidence that the experimental system was highly acceptable and comparable to a currently used HSAT. Continued innovation in reliable, cost-effective, low profile technologies will be critical to address the unmet needs of sleep diagnostic testing.
Support (if any): Anthem and Sibel Inc.

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SLEEP-DISORDERED BREATHING IN NATIVE HAWAIIANS/PACIFIC ISLANDERS WITH ASSOCIATED COMORBIDITIES AND ADHERENCE TO THERAPY

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Introduction: Sleep-disordered breathing in Native Hawaiians and Pacific Islanders (NHPIs), its relationship to type 2 diabetes mellitus (DM), chronic renal, and heart disease, is not well known. NHPIs comprise only 1.3% of Utah's population, but have the highest rates of DM and deaths due to diabetic kidney disease in Utah. This study assessed the nature of sleep-disordered breathing, its association with demographic variables, and comorbidities, and adherence patterns to positive airway pressure (PAP) therapy.
Methods: University of Utah sleep clinics patient databases from 2014 were evaluated to identify NHPIs using first/last names. Electronic medical records were reviewed to confirm patient ethnic origin, demographic data, and comorbidities. The most recent PAP downloads were obtained.
Results: Of 106 NHPIs were identified, data available for 104 patients (71 males, 33 females) was analyzed. Mean age of males was 47 + 13 years and females 48±13 years. Prevalence rates of obesity were 13% (female 9%, male 15%) with BMI≥30, 33% (female 24%, male 23%) with BMI≥35, and 49% (female 58%, Male 23%) with BMI≥40). Majority of patients had severe OSA (61% males with AHI≥30; 39% females with ≥ 30), with overall mean AHI of 47±38. A high prevalence of comorbidities was noted: 61% hypertension (male 58%; female 67%), diabetes 54% (male 48%, female 67%),

renal disease 20% (male 21%, female 18%), coronary artery disease 13% (male 14%, female 9%), and congestive heart failure 13% (male 15%, female 9%). Prevalence of lung disease was low 13% (male 9%, female 18%).

Conclusion: NHPIs evaluated for sleep-disordered breathing have high rates of obesity, severe OSA, and concerning comorbidities. PAP adherence in this group was poor compared to overall adherence for patients seen in University of Utah sleep clinics (~70%). Further research is required to assess the relationships between OSA, associated comorbidities, and disease outcomes. Addressing low rates of PAP adherence in this population may afford opportunities to improve health outcomes.

Support (if any): n/a

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THE EFFECT OF A PATIENT SURVEY IN THE EVALUATION OF OBSTRUCTIVE SLEEP APNEA IN A HIGH RISK CARDIOLOGY OUTPATIENT POPULATION

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Introduction: Obstructive sleep apnea (OSA) is the most common sleep-related breathing disorder. The estimated prevalence is approximately 15 to 30 percent in males and 10 to 15 percent in females. Patients with OSA have an increased propensity for cardiovascular diseases and obesity. Observational studies have demonstrated a consistent association between OSA and hypertension, coronary artery disease, cardiac arrhythmias, and heart failure. The purpose of this study is to evaluate if a patient survey can improve the diagnosis of OSA in a high-risk outpatient cardiac clinic.

Methods: In an outpatient cardiac clinic, a retrospective analysis of OSA evaluations was done before and after the use of patient surveys in a high-risk population. The high-risk patient group was defined by the presence of two or more of the following conditions: hypertension, heart failure, cardiac arrhythmias, atrial fibrillation, obesity with a BMI of 30 or more, coronary artery disease, diabetes mellitus, chronic lung disease, history of cerebrovascular accident (CVA), hypothyroidism and chronic renal insufficiency. The patient survey included questions on the presence of daytime sleepiness, presence of snoring, ESS score, choking in sleep, witness apnea, and frequent waking in sleep.

Results: During the four months of patient survey use, a total of 143 patients were evaluated as compared to 86 patients in the prior four months without the use of the survey. A significant increase (66.3%) of OSA evaluations was observed during the patient survey period.

Conclusion: The use of patient surveys showed a significant improvement in OSA diagnoses in the defined high-risk patient group. Patient surveys might be beneficial to improve the under diagnosis of sleep apnea in high-risk patient populations. Additional research needs to be done to establish the impact of such intervention on patient outcomes.

Support (if any):

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CLINICAL VALIDATION OF AI SCORING IN ADULT AND PEDIATRIC CLINICAL PSG SAMPLES COMPARED TO PROSPECTIVE, DOUBLE-BLIND SCORING PANEL

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Introduction: Despite an appreciable rise in sleep wellness and sleep medicine A.I. research publications, public data corpuses, institutional support, and health A.I. research funding opportunities, the availability of controlled-retrospective, hybrid-retrospective-prospective, and prospective-RCT quality clinical validation study evidence is limited with respect to their potential clinical impact. Furthermore, only a few practical examples of A.I. technologies are validated, in use today clinically, and widely adopted, to assist in sleep diagnoses and treatment. In this study, we contribute to this growing body of clinical A.I. validation evidence and experimental design methodologies with an interoperable A.I. scoring engine in Adult and Pediatric populations.

Methods: Stratified random sampling with proportionate allocation was applied to a database of N>10,000 retrospective diagnostic clinical polysomnography (PSG), selected by evidence grading standards, with controls applied for OSA severity, diagnoses; sleep, psychiatric, neurologic, neurodevelopmental, cardiac, pulmonary, metabolic disorders, medications; benzodiazepines, antidepressants, stimulants, opiates, sleep aids, demographic groups of interest; sex, adult age, pediatric age, BMI, weight, height, and patient-reported sleepiness, to establish representative N=100 Adult and N=100 Pediatric samples. Double Blinded scoring was prospectively collected for each sample by 3 experienced RPSGT certified sleep technologists randomized from a pool of 9 scorers. Sensitivity (PA), Specificity (NA), Accuracy (OA), Kappa (K), and 95% Bootstrap CI's are presented for sleep stages, OSA/CSA, hypopnea 3%/4%, arousals, limb movements, Cheyenne-Stokes respiration, periodic breathing, atrial fibrillation, and other events, and normative, mild, moderate, and severe OSA categories for global-AHI and REM-AHI. Results for Sleep Staging and OSA Severity Diagnostic Accuracy are summarized.

Results: A.I. scoring performance meet but in most cases exceeded initial clinical validation study (N=72 Adults, 2017) PA, NA, OA, K point-estimates and confidence-interval results for the 26 event types and 8 AHI-categories evaluated. The Adult sample showed 87%/94% Sensitivity/Specificity across all stages (Wake/N1/N2/N3/REM) and 94%/96% Sensitivity/Specificity for AHI>=15. The Pediatric sample showed 87%/93% Sensitivity/Specificity staging, 89%/98% Sensitivity/Specificity AHI>=15. Observed Accuracy was >90% for Adults and Pediatrics all 26 events and 7 AHI-categories analyzed, except REM-AHI>=5 (85%/82% Adults/Pediatrics).

Conclusion: We provide clinical validation evidence that demonstrates interoperable A.I. scoring performance in representative Adult and Pediatric patient clinical PSG samples when compared to prospective, double-blind scoring panel.

Support (if any):

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EXPLANATORY ANALYSIS OF POLYSOMNOGRAPHY FOR THE IDENTIFICATION OF SLEEP APNEA HYPOPNEA EVENTS USING DEEP LEARNING NEURAL NETWORK

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Introduction: Using deep learning algorithms, we investigated univariate and multivariate effects of four polysomnography features including heart rate (HR), electrocardiogram (ECG), oxygen saturation (SpO2) and nasal air flow (NAF) on the identification of sleep apnea and hypopnea events. This explanatory analysis that may clarify

the sensitivity and specificity of those features to SAs and SHs have not been probed.
Methods: We studied 804 polysomonography samples from 704 patients with obstructive sleep apnea and 100 controls. The input data were converted into scalograms as 4-channel 2D images to train Xception networks. For training, 77,638 patches were sampled from the original 6-hour sleep data with 30-second time width. A 10% of these patches were segregated as the test-set. With each feature sets, we tested the following classifications: 1) normal vs apnea vs hypopnea; 2) normal vs. apnea+hypopnea; 3) normal vs. apnea; and 4) normal vs. hypopnea.
Results: SpO2 classified normal vs. apnea most accurately (98%), followed by NAF (85%), ECG (77%), and HR (63%). SpO2 also showed the highest accuracy in classifying normal vs. hypopnea (87%), and normal vs. apnea+hypopnea (96%) and three groups (82%). When the combination of four features were used, the classification accuracies were generally improved compared to use of SpO2 only (normal vs. apnea 99%; vs. hypopnea 89%; vs. apnea+hypopnea: 94%; three groups: 86%).
Conclusion: Deep learning with SpO2 or NAF feature most accurately classified apneas from normal sleep events, suggesting these features' characterization of sleep apnea events. Oxygen desaturation, which is a typical pattern of hypopnea, was only the feature showing reliable accuracy in classifying hypopnea vs. normal. Nevertheless, combination of four polysomnography features could improve the identification of sleep apnea and hypopnea. Furthermore, classifying normal vs. apnea+hypopnea was more accurate than separately classifying three groups, suggesting deep learning approaches as the primary screen tool. Since the classification accuracy of using SpO2 was higher than any other features, developing a portable equipment measuring SpO2 and running deep learning algorithms has the potential for inexpensive, accurate diagnostics of obstructive sleep apnea syndrome.
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VALIDATION OF CLAIM BASED ALGORITHMS FOR SLEEP APNEA USING ICD CODES

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Introduction: Obstructive sleep apnea (OSA) is a common condition characterized by repeated episodes of partial or complete obstruction of the respiratory passages during sleep. According to recent studies prevalence of obstructive sleep apnea ranges between 9–38%. OSA is associated with increased all-cause mortality particularly associated with cardiac diseases. In order to provide representation of larger population estimates, administrative data using ICD codes have been utilized. Accurate identification of sleep apnea is important for research related to health care utilization and health outcomes. Our aim is to validate an algorithm for identification of patients with obstructive sleep apnea using ICD 10 codes seen at UTMB.
Methods: Patient medical records were collected from University of Texas Medical Branch EHR system. We included patients who visited from 6/1/2015 to 5/31/2018 in pulmonary or primary care clinics who had any sleep disorder diagnostic codes (ICD-10: G47.30, G47.31, G47.33, G47.34, G47.36, G47.20, G47.10, G47.39, G47.8, G47.9, F51.13, F51.09, R06.89, J96.90, R40.0, F51.9, R06.83, R06.3, G47.63, G47.39, Z86.69). Two algorithms were created. First algorithm included patient with sleep diagnostic codes used at 2 separate office visits. Second algorithm included patients with sleep diagnostic codes and evidence of sleep study. The performance of most used codes was calculated individually.
Results: 1200 patients were identified with ICD codes used during two office visits. According to the first algorithm with only ICD codes 75% of patients had sleep apnea. Upon addition of evidence of sleep apnea with ICD codes the % of patients with sleep apnea increased to 95.44. Among most used ICD codes, G47.30 had 86.47% patients with sleep apnea according to first algorithm and 96.01% with second algorithm. The percentages for G47.33 was 80.86% and 96.4%, for G47.10, 78.05% and 87.67%, for R40.0 78.91% and 90.63% respectively.
Conclusion: In conclusion, claim based algorithms for sleep apnea diagnostic codes showed good test positive percentages overall, but algorithm with ICD 10 codes with sleep study performed better in identifying patients with sleep apnea than ICD-9-CM codes alone. Similarly, the individual performance of most used ICD codes was highly improved when evidence of sleep study was present.
Support (if any):

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DYNAMIC PHENOTYPE LEARNING: A NOVEL MACHINE LEARNING APPROACH TO DEVELOP AND DISCOVER NEW OSA SUB-TYPES

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Introduction: Current approach to processing polysomnography is labor intensive and produces metrics that are poor at identifying obstructive sleep apnea (OSA) phenotypes necessary to enhance personalized care. We describe our approach to utilize Dynamic Phenotype Learning (DPL) as an innovative machine learning technique to identify OSA subtypes that can better predict clinical risk and success with therapies.
Methods: This study is a collaboration between Kaiser Permanente Southern California (KPSC), a large integrated health system, and EnsoData Research, which specializes in applied A.I. analysis of physiologic waveforms. KPSC sleep medicine compiled a database of N=5,368–234,250 subjects that include Types I, II, III, or IV sleep study data, daily PAP data, patient reported data, and comprehensive electronic health record information, with present research applications to study the relationship between OSA and PAP adherence with cardiovascular outcomes, health economic impacts, novel coronavirus (COVID-19) outcomes, and predictive PAP adherence and OSA severity clinical decision tools. DPL is a machine learning method for studying known and new biomarkers and care-pathway indices, including personalized screening, diagnostic, treatment, adherence, and outcomes predictors, that can be rooted in physiologic data. DPL processes waveform signal data without scoring, annotations, or expert synthesis, by applying a novel machine learning mechanism that blurs supervised and unsupervised deep learning paradigms, to find relationships between physiome dynamics expressed in waveforms and phenotypes and endotypes of interest.
Results: We demonstrate DPL method with an illustrative study on known indices, to explain its ability to (1) lift theoretical-empirical predictive accuracy ceilings and (b) reduce several sources of bias and variance. We show DPL exceeds the ROC-AUC and PRC-AUC of equivalent deep learning models in N=30,000 Report-Demographic (ODI, PLMSI, Weight), Scoring (REM, OSA), and Waveform (EEG, PPG) datasets respectively to predict AHI, TST, Brain Age, and OSA-Insomnia. We present our current collaboration advancing DPL to

identify specific phenotypes that better predict: (a) cardiovascular risk; (b) neurocognitive outcomes; (c) response to PAP and alternative therapies.
Conclusion: DPL methods are being applied to large and comprehensive patient dataset to identify phenotypic indices and biomarkers with potential to take us beyond the AHI, and uncover relationships between OSA sub-types, treatments, and health outcomes.
Support (if any):

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SLEEP AND STROKE: IMPROVED OSA TIME TO DIAGNOSIS FOR STROKE PATIENTS USING AN INPATIENT DIAGNOSTIC AND TREATMENT STRATEGY

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Introduction: Obstructive sleep apnea (OSA) is an independent risk for development of stroke. Despite this known relationship there is insufficient screening of sleep apnea in many recognized stroke centers, including Geisinger. In 2016, 68 patients were admitted to Geisinger Wyoming Valley (GWV) with ischemic stroke. Less than 10% had a Sleep Medicine Referral. When referred, average time to CPAP initiation was 9–12 months. An ongoing quality improvement (QI) study implemented inpatient home sleep apnea testing (HSAT) for stroke patients and subsequent autoPAP, if positive. Interim analysis demonstrates high rates of OSA using this screening method, suggesting a viable mechanism for improved time to OSA diagnosis.
Methods: All patients at GWV evaluated by neurology due to acute neurologic change were considered for enrollment (9/1/2019-10/10/2020). Only patients 18 years and older hospitalized with diagnosis of ischemic stroke were included. Patients were consented for participation. The evening of enrollment an Alice NightOne HSAT device was applied by a respiratory technician. If OSA was identified, the patient was placed on APAP the following evening.
Results: A total of 302 patients were screened with 82 patients meeting criteria for enrollment (27%) and 64 consenting for participation and attempting HSAT (21%). 18 of the 82 (22%) eligible patients refused participation. 12 patients (19%) had insufficient HSAT studies to determine OSA diagnosis. Of the patients who successfully completed an adequate HSAT study 85% (44/52) had OSA identified.
Conclusion: OSA is highly prevalent in patients with ischemic stroke and represents a modifiable risk factor for recurrent stroke. At baseline, rate of and time to diagnosis of OSA was poor with less than 10% of stroke patients receiving a sleep referral and time to initiation of CPAP was approximately 1 year. Standard universal in hospital surveillance for OSA using an HSAT in admitted stroke patients appears to allow for an increased rate of capture, but perhaps also a shorter time to diagnosis. This data may also suggest that prevalence of OSA in this stroke population is similar to slightly higher than previously reported. Further analysis of this program is required to evaluate for statistical significance and impact of APAP use.
Support (if any): Geisinger Health Plan

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REM PREDOMINANCE OF OSA: ASSOCIATED WITH SUPINE POSITION, BUT NOT WITH CPAP ADHERENCE

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Introduction: Obstructive sleep apnea (OSA) is a heterogeneous disease dependent on many factors including the sleep stage and the body position. OSA is often more severe during the rapid eye movement (REM) sleep stage, a phenomenon known as REM predominance. Prior studies suggested associations of higher REM predominance of OSA with younger age, higher obesity, and lower adherence to continuous positive airway pressure (CPAP) therapy, but these studies had small cohort sizes. Here we leverage home-based sleep tests (HST) that estimate REM sleep and measure body position to study REM predominance in a larger cohort of OSA patients.
Methods: We retrospectively reviewed patients who took HST at our clinic using devices based on peripheral arterial tonometry (WatchPAT, Itamar Medical). The HST results included estimated REM sleep periods and measured body positions. Auto-titrating CPAP therapy was prescribed for the majority of OSA patients diagnosed by the HST. Our inclusion criteria were: apnea-hypopnea index (AHI) above 5 / hour, estimated REM sleep time above 30 minutes, oxygen saturation below 90% (T90) for less than 10 minutes, and successful retrieval of CPAP usage data. CPAP adherence was defined as the percentage of nights with CPAP usage above four hours, and REM predominance as the ratio between REM AHI and non-REM AHI. Additionally, the percentage of estimated sleep time in supine position was calculated.
Results: Among 292 consecutive patients whose HST were reviewed, 113 patients met the inclusion criteria. The 25th-75th percentile ranges of age, body mass index (BMI), AHI, REM predominance, CPAP adherence and supine sleep percentage were 36–56 years, 28.1–38.4 kg/m2, 8.9–25.9 /hour, 1.27–2.89, 40%-97% and 28%-72%, respectively. REM predominance was not associated with CPAP adherence ($P > 0.05$), but was significantly associated with lower age, higher BMI, and higher supine sleep percentage (all $P < 0.01$).
Conclusion: We found that REM-predominant OSA is relatively more prevalent not only in young and obese patients, but in patients who sleep relatively more in the supine position. This association of REM predominance with body position is a novel finding to our knowledge. Contrary to prior studies, we did not find association of REM predominance with adherence to CPAP therapy.
Support (if any):

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PREVALENCE OF PULMONARY HYPERTENSION IN PATIENTS REFERRED FOR SLEEP APNEA DIAGNOSTICS

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Introduction: The aim to evaluate the prevalence of pulmonary hypertension according to echocardiography in patients referred for sleep apnea diagnostics.
Methods: We included 145 patients referred to Sleep laboratory for sleep apnea diagnostics. Mean age 63,8 ± 10,4 years, BMI 34,0 ± 5,7 kg/m2, AHI 31,3 ± 20,3/h, ODI 3% 28,2 ± 19,5/h, min SpO2 77,4 ± 9,8%, systolic pulmonary artery pressure (systolic PAP) 25,9 ± 16,4 mmHg. All patients underwent cardiorespiratory and respiratory diagnostics for sleep apnea and echocardiography.
Results: From the random sample of patients referred to Sleep laboratory 14,5% (21) had systolic PAP > 40 mmHg (by echocardiography). Patients with higher levels of systolic PAP (Systolic PAP, mmHg 49,9 [43,6; 56,2] vs 20,7 [19,9; 23,5],p=0.000) had more severe OSA (AHI 35,7 [27,1; 44,3] vs 26,6 [22,6; 30,6], p = 0.029, ODI 3%, /h 35,8 [25,1; 46,4] vs 23,8 [19,8; 27,8], p= 0.017) and were more obese (BMI 37,1 [33,8; 40,4] vs 33,4 [32,4; 34,5], p=0.024). Prevalence of AHI > 30 /h was 62% in group with systolic PAP > 40 mmHg vs 23% in the group with systolic PAP < 40 mmHg. We observed differences in echocardiography, in group with systolic PAP > 40 mmHg: left atrium (4.6 ± 0,5

vs 4,2 ± 0,4 cm, p=0.012), left atrium volume (94.0 ± 23.6 vs 71.7 ± 16.5 ml, p=0.001) and right atrium area (24.5 ± 4.9 vs 18.4 ± 3.8cm2, p=0.000) were higher. Though ejection fraction (58.2 ± 3.8 vs 59.0 ± 3.8%, p=0.268), interventricular septum thickness (1,13 ± 0,2 vs 1,06 ± 0,3 cm, p=0,654) and left ventricular posterior wall thickness (1,05 ± 0,08 vs 1,00 ± 0,13 cm, p=0,117) didn't differ. In terms of excessive daytime sleepiness, snoring and nocturia groups didn't differ, as well as for the prevalence of arterial hypertension, coronary artery disease, chronic heart failure, diabetes mellitus and chronic obstructive pulmonary disease.
Conclusion: Pulmonary hypertension is frequently observed in patients with OSA and appears to be related to the severity of sleep apnea and obesity. PH should be considered in the regular clinical assessment of all patients with sleep apnea, especially with severe form.
Support (if any):

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INPATIENT SLEEP SCREENS: EFFECTIVE FOR SCREENING BUT POOR FOLLOW UP

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Introduction: Only 20% of adult Americans with Obstructive Sleep Apnea (OSA) are thought to have been diagnosed. Portable monitors (PM) can provide shorter time to diagnosis and treatment in at risk populations including inpatients. Data on inpatient sleep screen testing outcomes and population phenotypes are limited. We hypothesized that inpatients undergoing sleep screens via PM have higher disease severity but are less adherent to follow up.
Methods: We conducted a retrospective observational study comparing severity of OSA based on apnea-hypopnea index (AHI) and compliance with follow up between patients who received inpatient vs. outpatient sleep screens. There was a total of 347 patients, 18 years and older, who received a sleep screen from August 2017 to August 2018. Exclusion criteria were cancellations/no shows (13.56% inpatients vs. 13.51% outpatients) or loss of data (26.12% inpatients vs. 23.72% outpatients). For analysis, t-test and chi-square were used for continuous and categorical variables respectively.
Results: The patients diagnosed with severe OSA were more than double in the inpatient group vs. the outpatient group, 46.7% and 21.7% respectively. The inpatient group had a higher average AHI (30/h) compared to the outpatient group (20.3/h). 30.7% of the inpatient group were adherent with their follow up vs. 83.3% of the outpatient group. A chi-square test of independence demonstrated a significant difference between testing location and follow up ($p < .001$). Those in the inpatient group were significantly older (mean 60.4 years old) than the outpatient group (47.5 years old). There was no significant difference in gender between the groups. The inpatient group had significantly higher average body mass index (39.9 kg/m2) when compared to the outpatient group (34.3 kg/m2).
Conclusion: Hospitalized patients screened for OSA with portable monitors are significantly more likely to have severe disease when compared to outpatients. Despite this, adherence to follow up is poor. Systematic evaluation of inpatient OSA screening program effectiveness and factors impacting adherence to follow up and treatment are needed.
Support (if any):

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DEEP NEURAL NETWORKS: A SURVEY TOOL FOR OBSTRUCTIVE SLEEP APNEA PREDICTION

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Introduction: Obstructive sleep apnea (OSA) is a common sleep-related breathing disorder with an estimation of one billion people. Full-night polysomnography is considered the gold standard for OSA diagnosis. However, it is time-consuming, expensive and is not readily available in many parts of the world. Many screening questionnaires and scores have been proposed for OSA prediction with high sensitivity and low specificity. The present study is intended to develop models with various machine learning techniques to predict the severity of OSA by incorporating features from multiple questionnaires.
Methods: Subjects who underwent full-night polysomnography in Torr sleep center, Texas and completed 5 OSA screening questionnaires/scores were included. OSA was diagnosed by using Apnea-Hypopnea Index ≥ 5. We trained five different machine learning models including Deep Neural Networks with the scaled principal component analysis (DNN-PCA), Random Forest (RF), Adaptive Boosting classifier (ABC), and K-Nearest Neighbors classifier (KNC) and Support Vector Machine Classifier (SVMC). Training:Testing subject ratio of 65:35 was used. All features including demographic data, body measurement, snoring and sleepiness history were obtained from 5 OSA screening questionnaires/scores (STOP-BANG questionnaires, Berlin questionnaires, NoSAS score, NAMES score and No-Apnea score). Performance parametrics were used to compare between machine learning models.
Results: Of 180 subjects, 51.5 % of subjects were male with mean (SD) age of 53.6 (15.1). One hundred and nineteen subjects were diagnosed with OSA. Area Under the Receiver Operating Characteristic Curve (AUROC) of DNN-PCA, RF, ABC, KNC, SVMC, STOP-BANG questionnaire, Berlin questionnaire, NoSAS score, NAMES score, and No-Apnea score were 0.85, 0.68, 0.52, 0.74, 0.75, 0.61, 0.63, 0,61, 0.58 and 0,58 respectively. DNN-PCA showed the highest AUROC with sensitivity of 0.79, specificity of 0.67, positive-predictivity of 0.93, F1 score of 0.86, and accuracy of 0.77.
Conclusion: Our result showed that DNN-PCA outperforms OSA screening questionnaires, scores and other machine learning models.
Support (if any):

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RISK OF OBSTRUCTIVE SLEEP APNEA AFTER TREATMENT OF HEAD AND NECK SQUAMOUS CELL CARCINOMA

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Introduction: Head and neck cancers (HNC) or their treatment may be associated with an increased risk of obstructive sleep apnea (OSA). Small studies that examined OSA risk factors in adults with HNC reported conflicting results. This study examined associations between tumor characteristics and risk of OSA among patients at least one year free of head and neck squamous cell carcinoma (HNSCC).
Methods: For this cross-sectional study of HNSCC patients at a large academic medical center, inclusion criteria were age ≥18 years, with absence of tracheostomy or mental impairment. The STOP-BANG questionnaire, with a threshold ≥3, was used to identify high risk for OSA. Descriptive statistics were used to compare demographic and health characteristics between OSA risk groups. Logistic and linear regression models adjusted for age and gender were used to examine

associations between demographics, anthropometric measures, and OSA risk.

Results: Among 67 participants, 57 (85%) were male, mean age was 62.0±8.0 (s.d.) years, mean body mass index (BMI) was 28.7±4.6 Kg/m2, and mean neck circumference (NC) was 16.3±1.2 inches. A total of 50 (75%) participants received chemoradiation only. High OSA risk was observed in 40 (60%) of the participants. Tumor location, tumor stage, and type of cancer treatment were not different between OSA risk groups. Body mass index and NC were greater in the high OSA risk group (BMI 29.6±4.5 Kg/m2 vs. 27.3±4.1 Kg/m2, p=0.03; NC 16.5±1.3 inches vs. 15.8±0.5 inches, p=0.01). In age and gender-adjusted logistic regression models, BMI (OR=1.2, 95% CI 1.0, 1.4) and NC (OR=2.9, 95% CI 1.1, 7.3) were associated with high OSA risk. Adjusted linear regression models showed that BMI (β=0.10, 95%CI 0.04, 0.17) and NC (β=0.64, 95%CI 0.32, 0.96) were associated with STOP-BANG scores.

Conclusion: High OSA risk was quite common after HNSCC treatment. However, measured HNSCC characteristics were not different between high and low OSA risk groups. Instead, OSA risk factors included BMI and NC, as often reported in non-HNSCC patients as well. Prospective studies before and after cancer treatment will be needed to further elucidate potential roles of HNSCC and its treatment in subsequent OSA incidence.

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THE IMPACT OF OBSTRUCTIVE SLEEP APNEA SEVERITY ON AGE-RELATED COMORBITIES: A POPULATION-BASED STUDY

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Introduction: Although age per se has been considered a risk factor for OSA, evidence suggest OSA in older adults may be less severe and OSA diagnostic criteria might be adjusted for this age group. Concurrently, it is likely the late-onset OSA is a distinct phenotype having different pathophysiological mechanisms, as well as clinical manifestations and consequences. We sought to investigate the clinical consequences of OSA severity in older adults from a representative sample of the older population living in the São Paulo city.

Methods: From the baseline survey including 1042 participants in 2007, 715 were reassessed in 2016 completing full in-lab PSG, health-related questionnaires, blood tests, and blood pressure measurements. Individuals > 60 y.o. (n=199) of both genders were included in the analysis. Participants were stratified according to OSA presence and severity in 3 groups G1 (non and mild OSA n=83); G2 (moderate OSA n=56); G3 (severe OSA n=60). General Linear Model (GLM) tests and Chi-square were carried out.

Results: Participants mean age was 70.02±7.31 and mean body mass index (BMI) 28.61±5.39, 40.71% of men. The only comorbidity associated with OSA severity was arterial hypertension occurring in 61.7% of G3, 46.4% of G4 and 41% of G1 (p=0.04). Severe OSA participants were more likely to use a higher (>2/day) number of medications (p=0.03). Finally, out of all blood tests only cortisol was significantly higher in severe OSA group (p<0.001)

Conclusion: Severe OSA in older individuals of the general population is not associated with metabolic conditions, such as diabetes, but it was associated with hypertension. Severe OSA may be a stressful condition, since it was associated with higher cortisol in this population.

Support (if any): Associaçao Fundo Incentivo a Pesquisa (AFIP)

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TRANSGENDER HORMONE THERAPY AND SLEEP-DISORDERED BREATHING

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Introduction: Sex hormones may affect human respiration during wakefulness and sleep. Testosterone has been associated with increased obstructive respiratory events contributing to sleep-disordered breathing (SDB) in men, whereas a protective effect against SDB has been attributed to estrogen in women. These associations, primarily observed in cisgender populations, have been rarely examined in transgender individuals on hormone replacement therapy (HRT). The present study investigated associations between HRT and SDB in transgender adults.

Methods: A chart review of medical records from transgender patients was conducted in a large academic sleep medicine center. Individuals were included if they were at least 18 years old, had one or more sleep complaints, and SDB testing results available. Participants were then stratified by affirmed gender (transmasculine and transfeminine) and by HRT status. We used descriptive statistics procedures to examine differences between gender and HRT groups. Associations between HRT and the apnea-hypopnea index (AHI) were estimated with age-adjusted linear regression models.

Results: Of the 194 individuals identified, 89 satisfied the inclusion criteria. Nearly half of participants were transmasculine (52%). The mean age was 38±13 years, and mean body mass index was 34.7±9.0 Kg/m2. Approximately 60% of participants were on HRT at the time of SDB evaluation. Transmasculine people who were prescribed testosterone had a significantly increased AHI and lower oxygen nadir in comparison to transmasculine individuals not on testosterone (AHI 36.8±37.8/hour vs.15.3±16.6/hour, p=0.01; oxygen nadir 83.4±8.3% vs. 89.1±2.4%, p=0.001). In contrast, differences between transfeminine people with and without feminizing HRT (androgen blocker + estrogen) were not statistically significant (AHI 21.4±27.7/hour vs. 27.7±26.0/hour, p=0.45; oxygen nadir 86.5±6.7% vs. 84.1±7.7%, p=0.29). Linear regression models adjusted for age found an association between HRT and AHI for transmasculine (β=16.7, 95% CI 2.7, 30.8), but not for transfeminine participants (β=-2.5, 95% CI -17.9, 12.9).

Conclusion: These findings suggest differential associations between HRT and AHI among transgender individuals, with transmasculine on testosterone having a significant increase in AHI. Prospective studies with large sample sizes are warranted to evaluate these associations.

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THE BERLIN QUESTIONNAIRE IN PREGNANCY PREDOMINANTLY IDENTIFIES OBESITY

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Introduction: Obstructive sleep apnea (OSA) is common in pregnant women and is a risk factor for poor perinatal outcomes. The Berlin Questionnaire (BQ) is a validated OSA screening tool that is often used in pregnancy. However, it performs poorly in this population, likely attributed to the scoring paradigm that primarily identifies obesity. Moreover, the associations between the BQ and pregnancy outcomes are often those same outcomes that are obesity-related. Therefore, this

study examined associations between each of the three BQ domains, independently and jointly, in relation to gestational diabetes (GDM) and hypertensive disorders of pregnancy (HDP).
Methods: Pregnant third-trimester women aged at least 18 years with a single fetus were recruited from a tertiary medical center. All women completed the BQ, which includes three domains: snoring; sleepiness; and obesity/high blood pressure (BMI/BP). The latter domain was further examined as two separate sub-domains: obesity or chronic hypertension. A positive response in 2-of-3 domains identifies high OSA risk. Medical records were accessed for diagnoses of GDM and HDP.
Results: Of 1,588 women, 44% had a positive BQ. Women with positive domains of snoring exclusively, sleepiness exclusively, or their combination did not have an increased risk of GDM or HDP. However, women without snoring or sleepiness, but with a positive score on the BMI/BP domain had increased odds of GDM (OR 2.0, 95%CI 1.3–3.3) and HDP (OR 2.9, 95%CI 1.6–5.5). Any positive score in domain combinations that included BMI/BP had increased odds of GDM and HDP compared with negative scores in all domains. A positive score in BMI/BP-alone, BMI/BP-and-sleepiness, BMI/BP-and-snoring, and an intersection of all three domains, had increased HDP odds compared with controls: OR 2.9 (95%CI 1.6–5.5), OR 2.2 (95%CI 1.1–4.4), OR 2.9 (95%CI 1.5–5.7), and OR 4.6 (95%CI 2.6–8.6), respectively. Women absent of positive BMI/BP domain but with a positive score in the other two domains (or their combination) had similar odds of GDM and HDP as controls.
Conclusion: The poor performance of the BQ in screening for OSA risk in pregnant women may be attributed to its predominant reliance on identification of obesity.
Support (if any): NIH NHLBIHL089918

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STOP-BANG SCORE AND HISTORY OF RADIATION PREDICTS RISK OF OBSTRUCTIVE SLEEP APNEA IN CANCER PATIENTS: A MACHINE LEARNING STUDY

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Introduction: Cancer patients are at an increased risk of moderate-to-severe obstructive sleep apnea (OSA). The STOP-Bang score is a commonly used screening questionnaire to assess risk of OSA in the general population. We hypothesize that cancer-relevant features, like radiation therapy (RT), may be used to determine the risk of OSA in cancer patients. Machine learning (ML) with non-parametric regression is applied to increase the prediction accuracy of OSA risk.
Methods: Ten features namely STOP-Bang score, history of RT to the head/neck/thorax, cancer type, cancer stage, metastasis, hypertension, diabetes, asthma, COPD, and chronic kidney disease were extracted from a database of cancer patients with a sleep study. The ML technique, K-Nearest-Neighbor (KNN), with a range of k values (5 to 20), was chosen because, unlike Logistic Regression (LR), KNN is not presumptive of data distribution and mapping function, and supports non-linear relationships among features. A correlation heatmap was computed to identify features having high correlation with OSA. Principal Component Analysis (PCA) was performed on the correlated features and then KNN was applied on the components to predict the risk of OSA. Receiver Operating Characteristic (ROC) - Area Under Curve (AUC) and Precision-Recall curves were computed to compare and validate performance for different test sets and majority class scenarios.
Results: In our cohort of 174 cancer patients, the accuracy in determining OSA among cancer patients using STOP-Bang score was 82.3% (LR) and 90.69% (KNN) but reduced to 89.9% in KNN using all 10 features mentioned above. PCA + KNN application using STOP-Bang score and RT as features, increased prediction accuracy to 94.1%. We validated our ML approach using a separate cohort of 20 cancer patients; the accuracies in OSA prediction were 85.57% (LR), 91.1% (KNN), and 92.8% (PCA + KNN).
Conclusion: STOP-Bang score and history of RT can be useful to predict risk of OSA in cancer patients with the PCA + KNN approach. This ML technique can refine screening tools to improve prediction accuracy of OSA in cancer patients. Larger studies investigating additional features using ML may improve OSA screening accuracy in various populations
Support (if any):

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EVALUATING THE RATE OF REFERRAL FOR OBSTRUCTIVE SLEEP APNEA IN A PRE-DOCTORAL DENTAL CLINIC USING THE STOP-BANG QUESTIONNAIRE

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Introduction: The STOP-Bang Questionnaire is a validated instrument to assess an individual's risk for obstructive sleep apnea (OSA). The prevalence of OSA is estimated at 20% in the US with only 20% of those individuals properly diagnosed. Dentists are being asked to screen and refer patients at high risk for OSA for definitive diagnosis and treatment. The aim of this study was to determine whether patients in a dental school student clinic who were identified as high-risk for OSA, were referred for evaluation of OSA.
Methods: All new patients over the age of 18 admitted to The Ohio State University - College of Dentistry complete an "Adult Medical History Form". Included in this study were 21,312 patients admitted between July 2017 and March 2020. Data were extracted from the history form to determine the STOP-Bang Score for all patients: age, sex, BMI, self-reported snoring-, stopped breathing/choking/gasping while sleeping-, high blood pressure-, neck size over 17" (males) or 16" (females)-, and tiredness. Each positive response is a point, for a maximum of 8 points possible. Additionally, any previous diagnosis of sleep apnea, and the patient's history of referrals were extracted from the health record. According to clinic policy, if the patient did not have a previous diagnosis for OSA noted in the health history, and scored 5 or more on the STOP-Bang Questionnaire, they should receive a referral for an evaluation for OSA. Notes and referral forms were reviewed to determine if the appropriate referrals occurred for patients at high risk without a previous diagnosis.
Results: Of the 21,312 patients screened; 1098 (5.2%) screened high-risk for OSA, of which 398 had no previous diagnosis of OSA. Of these 398 patients, none (0%) had referrals for further evaluation for OSA.
Conclusion: The rate of appropriate referrals from a student dental clinic with an electronic health record was unacceptably low. Continued education and changes to the electronic health record are needed to ensure those at high-risk for OSA are appropriately referred and managed.
Support (if any):

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ELUCIDATING CIRCADIAN AND SLEEP PHENOTYPES AND RELATION TO COGNITIVE IMPAIRMENT IN ALZHEIMER'S DEMENTIA

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Introduction: Although sleep disruption in Alzheimer's disease (AD) pathogenesis has been described, the role of circadian rhythm dysfunction (CRD) is less understood. We hypothesize greater CRD and sleep disruption with poorer cognitive function in AD compared to normal cognition.
Methods: We examined 3 groups:1)mild cognitive impairment with positive AD biomarkers(MCI-AD),n=18, 2)cognitively normal at high risk for AD(HR)(APOEε4 carriers),n=19, 3)cognitively normal APOEε4 non-carriers(CL),n=16 (National Institute of Aging, IMMUNE-AD). DNA extraction and APOEε4 genotyping were performed under the Cleveland Clinic Lou Ruvo Center for Brain Health Aging and Neurodegenerative Disease Biobank. We evaluated actigraphy-based (Motionlogger MicroWatch, Ambulatory Monitoring,Inc®) sleep (wake episodes(WE), total sleep time(TST), sleep efficiency(SE), sleep fragmentation index(SFI)) and circadian (mesor, amplitude, robustness, sleep regulatory index(SRI), intradaily stability) predictors and sleep study-based (ApneaLink Air by ResMed®) predictors (apnea hypopnea index(AHI,3% desaturation) and recording time<90%SaO2) across the groups and assessed association with cognition (Mini-Mental State Exam(MMSE)). Analysis of variance (ANOVA) or Kruskal-Wallis with Bonferroni adjustment was used for cross-group comparisons. ANCOVA assessed cross-group association of MMSE and sleep/circadian indices. Models were adjusted for age, sex, race, education, and BMI.
Results: Age differed across MCI-AD, HR, and CL groups (68.4±6.2,71.2±3.7,73.7±3.7 respectively,p=0.008). MCI-AD had more WE than HR and CL (14.4±5.6,10.9±3.9,10.9±3.5 respectively,p=0.033). In MCI-AD, the following associations were observed: 5% increase in SE was associated with 0.49 point higher MMSE (coefficient0.49, 95%CI[0.03,0.95],p=0.038), 1 hour increase in TST was associated with 0.81 point higher MMSE (coefficient0.81, 95%CI[0.24,1.37],p=0.006), and 1 unit increase in SFI was associated with 0.36 point lower MMSE (coefficient-0.36, 95%CI[-0.64,-0.08],p=0.013). Key measures differed: CLs had lower AHI, MCI-AD had less TST SaO2<90%, MCI-AD had the largest and HR the lowest SFI, and MCI-AD had lesser robustness but higher mesor and amplitude.
Conclusion: In this comparative study of carefully AD biomarker-phenotyped and APOEε4-genotyped patients and normal cognition controls, less sleep time and more fragmented sleep are associated with poorer MMSE scores in MCI-AD. Preliminary results show cognitively normal participants at risk of AD(HR) do not show CRD seen in MCI-AD and are more consistent with controls (CL).
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INFLUENCE OF SEX-SPECIFIC DIFFERENCES IN INPATIENT SLEEP TESTING APPROACH FOR DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Increased attention has been focused on sex-specific differences in approaches to diagnostic testing for obstructive sleep apnea (OSA) given differences in hypoxia, arousal thresholds and sleep state dependent influences, but with sparse data available for inpatient testing. We postulate that women are more likely to have a lesser degree of sleep apnea on inpatient home sleep apnea testing (HSAT) versus polysomnography (PSG).
Methods: The Cleveland Clinic Sleep Laboratory registry was queried for inpatient sleep testing (HSAT or PSG conducted over the last 15 years. Demographics, comorbidities, and sleep study (Nihon Kohden®) data were collated. Logistic regression was used to examine sleep study type predictive of OSA at various severity thresholds (apnea hypopnea index (AHI, 3 or 4% hypopnea rule)>5,>15 and >30 and hypoxia (11% (median) time spent with SaO2<90%) adjusted for age, race and body mass index and comorbidities (hypertension, coronary artery disease, arrhythmias, heart failure, diabetes, stroke, chronic obstructive pulmonary disease, mood disorders, respiratory failure and epilepsy with a sex interaction term) (OR, 95%CI presented).
Results: The analytic sample was comprised of 639 patients: age:55.8±16.3 years, 45% female, 73% Caucasian, BMI:37.5 ± 13.3kg/m2, 74% had OSA and 51% HSAT. Men had higher AHI:16.2 [5.9, 42.3] vs 8.2 [2.9, 20.7]p<0.001, higher arousal index:33.1[18.9,.54] vs 25.3 [15.6, 39.2]p=0.003. Women had higher BMI:40.2 ±14.7, vs 36 ±11.7kg/m2,p<0.001. Unlike AHI>5, at AHI>15, men had lower odds of OSA: OR=0.51:0.32–0.80,p=0.004 for HSAT versus PSG compared to women: OR=1.03:0.61–1.72,p=0.92; interaction p-value=0.046. Men had lower odds of OSA (AHI >30): OR=0.57(0.35,0.92,p=0.022) in HSAT vs PSG; albeit sex-interaction was not statistically significant. Men versus women had 2-versus 3-fold higher hypoxia ie. OR=2.04:1.22–3.41,p=0.006 in men undergoing HSAT versus PSG with strength of association higher in women: OR=3.03:1.68–5.46,p=0.001, interaction p-value=0.32
Conclusion: We unexpectedly observe sex-specific differences in inpatient sleep testing such that men had an overall lower odds of detection of moderate to severe and OSA and nocturnal hypoxia relative to women with HSAT versus PSG. Future investigation focused on concurrent inpatient PSG and HSAT should verify these sex-specific findings and clarify potential biophysiologic rationale
Support (if any): Transformative Neuroscience Research Development Program: Multimodal Neurocardiorespiratory Physiologic Sleep Signal Repository Transformative Resource Facilitating Transdisciplinary Research Opportunities

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EVALUATION OF ELECTRONIC MEDICAL RECORD ARTIFICIAL INTELLIGENCE SCREENING TOOLS FOR UNDIAGNOSED OSA

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Introduction: The STOP-Bang is a concise, simple and widely adopted obstructive sleep apnea (OSA) screening tool. However, it has limited predictive ability and is susceptible to subjective reporting bias. Artificial Intelligence (AI) methodologies can be utilized together with existing data in electronic medical records (EMRs) to create new screening tools to increase diagnostic sensitivity and facilitate discovery of preclinical OSA phenotypes.
Methods: The study comprised two independent retrospective sleep study datasets: 1) Type III HSATS (N=5583) and, 2) Type I polysomnograms (N=1037). Each contained raw sleep study waveforms, manually scored sleep events (respiratory, arousal, sleep staging), and standard report indices (apnea-hypopnea index; AHI, arousal index). Additionally, the first dataset contained 90 EMR based

metadata variables and the second dataset contained 54 EMR based metadata variables. Three random forest models were trained to detect OSA diagnostic thresholds (AHI> 5, AHI>15, and AHI>30) over three different screening models: STOP-Bang, P-Bang (blood-pressure, BMI, age, neck-size, gender), and Common Clinical Data Set (CCDS)-OSA (all metadata variables simulating EMR CCDS standard).
Results: CCDS-OSA ROC-AUC exceeded STOP-Bang and P-Bang for both sleep study collections, resulting in AHI>15 ROC-AUC values of 0.73 and 0.71 (CCDS-OSA) compared to AHI>15 ROC-AUC values of 0.68 and 0.69 (STOP-Bang). Additionally, we analyzed the Gini feature importance ranking of the trained CCDS-OSA model to evaluate which variables showed highest predictive value of OSA. The ranking revealed the top 5 features were the five physiologic based STOP-Bang parameters, followed by EMR based physiologic measurements such as HDL, triglycerides, systolic BP, and disease conditions such as diabetes, hypertension, and depression.
Conclusion: This study shows that while STOP-Bang contains data critical to OSA screening, a variety of other EMR-based parameters can improve performance of OSA detection. AI-based EMR screening can provide a critical tool for more systematic and accurate screening of undiagnosed sleep apnea. Nationwide standards facilitating patient EMR data interoperable health information exchange, particularly the United States Core Data for Interoperability (USCDI CCDS), holds promise to foster broad clinical and research opportunities. Resulting data sharing will allow application of AI screening tools at the population health scale with ubiquitous, existing EMR data to improve population sleep health.
Support (if any):

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ADVANCED GESTATIONAL AGE IS A PREDICTOR OF NON-COMPLETION OF SLEEP APNEA TESTING IN PREGNANCY

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Introduction: Sleep apnea is emerging as an important and underdiagnosed comorbidity in pregnancy. Screening, diagnosis, and initiation of therapy are all time-sensitive processes during the dynamic progression of gestation. Completion of referral and testing for sleep apnea during pregnancy requires a significant commitment of time and effort on the part of the pregnant patient. We evaluated for predictors of non-completion of sleep apnea testing within our obstetric-sleep referral pipeline, in an effort to inform and optimize future referrals.
Methods: We performed a retrospective chart-review of 405 pregnant patient referrals for sleep apnea evaluation at the University of Wisconsin-Madison/UnityPoint sleep apnea pregnancy clinic. We used logistic regression analysis to determine predictors of lack of completion of sleep apnea testing.
Results: The vast majority of referrals (>95%) were triaged directly to home sleep apnea testing with the Alice PDX portable device, rather than a sleep clinic visit. The overall rate of referral non-completion was 59%. Predictors of non-completion of sleep apnea evaluation in our pregnant population included higher gestational age (GA) at referral (1–12 wks GA: 30%, 13–26 wks GA: 31%, and 27–40 wks GA: 57% non-completers, p=0.006) and multiparity with 1 or more living children (65% non-completers if any living children, compared to 45% non-completers if no living children, p=0.002). Age, race, and transportation were not predictors of failure to complete sleep apnea testing.
Conclusion: We have identified several predictors of pregnant patients' failure to complete sleep apnea evaluation with objective home sleep apnea testing after referral from obstetrics. Not surprisingly, higher gestational age emerged as a strong negative predictor of referral completion, with >50% of patients referred in the third trimester not completing sleep apnea testing. Early screening and referral for sleep apnea evaluation in pregnancy should be prioritized, given the time-sensitive nature of diagnosis and therapy initiation, and demonstrated reduced completion of referrals in advanced pregnancy.
Support (if any): None

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INVESTIGATING THE UTILITY OF ROUTINE CARBON DIOXIDE MEASUREMENTS DURING POLYSOMNOGRAPHY IN THE EVALUATION OF OBESE ADULT PATIENTS

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Introduction: With the increasing prevalence of obesity, the diagnosis of obstructive sleep apnea (OSA) and obesity hypoventilation syndrome (OHS) have also increased. Adding routine transcutaneous carbon dioxide (TcCO2) or end-tidal carbon dioxide sensors (EtCO2) may add beneficial information to the polysomnogram (PSG) and expand the diagnostic and treatment capabilities in this population. Our study looks at the use of this parameter in obese adults on whom CO2monitoring has been used.
Methods: We performed a retrospective chart review of obese adult patients (body mass index [BMI] >30) undergoing a PSG. We documented the EtCO2 values at baseline (supine awake) and during sleep. Correlations between the EtCO2 readings and BMI were reviewed. We excluded patients that had poor EtCO2 waveforms and patients with known preexisting hypoventilation syndromes, such a COPD.
Results: Fifty patients were identified between January and November 2020 at the Memorial Hermann Sleep Center. 54% were female and 46% were male with an average age of 55.3 years (range 26–73) and an average BMI for the cohort of 40.1 (SD +/-9.5). The average AHI on the diagnostic study (CMS criteria) was 30.9 events/hour (SD +/-43) and the average oxygen desaturation nadir was 79%. Sixteen patients (32%) met diagnostic criteria for OHS based on the baseline awake EtCO2 which would have otherwise been missed without CO2 monitoring. When comparing the mean values of the ETCO2 between Group 1 whose BMI was less than 40 kg/m2 (39.9 mmHg) to Group 2 whose BMI was greater than 40 kg/m2 (45.9 mm Hg), the difference was statistically significant with a p-value is 0.001.
Conclusion: OHS is reported to have greater mortality when compared to OSA. CO2 monitoring is currently only routinely required in pediatric PSGs. Our review suggests a higher diagnostic yield of OHS in adults with the use of CO2 monitoring especially when morbidly obese. Given the alarming trend towards obesity in the US, this advocates for the routine use of CO2 monitoring in adult obese patients. Although more research is needed, we may draw a conclusion that there is meaningful data to support the use of routine ETCO2 monitoring in this adult patient population.
Support (if any):

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CLINICAL VALIDATION OF A.I. ANALYSIS OF PHOTOPLETHYSMOGRAM (PPG) BASED SLEEP-WAKE STAGING, TOTAL SLEEP TIME, AND RESPIRATORY RATE

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Introduction: The Photoplesthymogram (PPG) raw waveform is the basis for both the pulse rate and oximetry during polysomnography (PSG) and Home Sleep Apnea Tests (HSAT). The PPG has also recently become ubiquitous as a basis of continuous measurement for the most widely adopted consumer sleep technologies, particularly smart watches. In this study, we clinically validate AI performance for interoperable, PPG-based epoch-by-epoch Sleep-Wake staging (PPG-SW), Total Sleep Time (PPG-TST), and Respiratory Rate (PPG-RR), when compared to 1) PSG-based panel scoring by technologists (RPSGTs) and 2) PSG-based AI scoring (EEG-SW, EEG-TST, Effort Belt-RR).
Methods: We applied stratified random sampling with proportionate allocation to a database of N>10,000 retrospective PSGs. We controlled for: 1) Obstructive sleep apnea severity, 2) Sleepiness, 3) Medical diagnoses including sleep, psychiatric, neurologic, neurodevelopmental, cardiac, pulmonary, metabolic disorders, 4) Medications including benzodiazepines, antidepressants, stimulants, opiates, sedative-hypnotics, 5) Demographics including sex, age, BMI, weight, and height, to establish representative adult (N=100) PSG studies from which PPG samples were obtained. Double blinded scoring was prospectively collected for each PSG by 3 experienced RPSGTs randomized from a pool of 6 scorers. RR was established by mode when two scorers agreed on RR value and median otherwise.
Results: AI EEG-SW demonstrated 96%/94%/95% Sensitivity/Specificity/Accuracy compared to 2/3 majority PSG staging, and AI PPG-SW demonstrated 90%/89%/90% Sensitivity/Specificity/Accuracy compared to the same PSG panel. AI EEG-TST achieved a Pearson Correlation Coefficient (R-value) of 0.968 and AI PPG-TST achieved 0.873 R-value compared to 2/3 majority PSG-TST. When compared to the RR panel consensus in N=282 one-minute RR scoring epochs of PSG, AI Effort Belt-RR performance was <= 2 breaths-per-minute (brpm) in 93.6% of epochs with an average difference of 0.992 brpm, and AI PPG-RR performance was <= 2 brpm in 92.2% of epochs with an average difference of 0.996 brpm.
Conclusion: The study shows interoperable AI analysis performs robustly in evaluating PPG-based epoch-by-epoch sleep-wake stages, total sleep time, and respiratory rate, demonstrating state-of-art accuracy when compared to a prospective, double-blinded PSG scoring panel. This work has implications for consumer sleep technology, HSAT accuracy, inpatient sleep monitoring, and may support the growth of HSATs by increasing total sleep time accuracy and reliability.
Support (if any):

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COMPARISON OF PAP INTERFACE PRESSURE ON THE NASAL BRIDGE: SOFT CLOTH VS. TRADITIONAL MASKS

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Introduction: Pressure between a CPAP mask and the skin is a significant contributor to irritation and pressure ulcers, an area of localized soft tissue ischemic necrosis caused by prolonged pressure over bony prominences that exceeds supra capillary pressure (70 mmHg). We hypothesized that cloth masks (CM) would exert a lower nasal bridge pressure than traditional mask (TM) products constructed of silicone and plastic.
Methods: We evaluated the pressure exerted by seven types of nasal masks in three trials onto the nasal bridge of two healthy adult volunteers, one female, one male, while they received 10 cm H_2O of CPAP. Five commercially available CMs (SleepWeaver® 3D, SleepWeaver® Advance Pediatric, SleepWeaver® Élan, and SleepWeaver® Prevent, Circadiance®, LLC) were tested as were three TMs constructed primarily of silicone and plastic (DreamWisp™, Philips Respironics, Inc.; Mirage™, ResMed; Zest™, Fisher & Paykel Healthcare). Pressure was detected using a texsens®-g low pressure sensor force measuring device. Pressure data from each 30 second trial were summarized as the median value after confirming that pressure did not vary by time (one-way ANOVA, p = 0.7393). Median values were then compared across trials, subjects, and masks using one-way ANOVAs and student's t-tests.
Results: After confirming that pressure did not vary by trial (one-way ANOVA, p=0.4585) or subject (t-test, p=0.0938), pressure data were summarized by mask. On average, CMs exerted 37.0 (17.7) mmHg of nasal bridge pressure, although there was significant variation across masks (one-way ANOVA, p < 0.0001). Conversely, TMs averaged 112 (38.5) mmHg of nasal bridge pressure without significant variation across masks (one-way ANOVA, p=0.1291). CMs averaged 75.26 mmHg less pressure than TMs (p < 0.0001), a difference of 67 percent.
Conclusion: The data supports the hypothesis that pressure from CMs on the bridge of the nose are significantly lower than a sample of TMs with similar shape and style, and the null hypothesis was rejected. Furthermore, the average CM was below the threshold for capillary closing, in contrast to the average TM. Therefore, for CPAP users with predicted or existing skin sensitivity, comfort and/or compliance concerns, CM should be considered as a first choice in mask selection.
Support (if any):

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BAROREFLEX SENSITIVITY DURING HANDGRIP IN OBSTRUCTIVE SLEEP APNEA WITH AND WITHOUT CPAP

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Introduction: Obstructive sleep apnea (OSA) disrupts multiple aspect of autonomic regulation; it is unclear whether intervention with continuous positive airway pressure (CPAP) can correct such disruptions. One key index of autonomic regulation is baroreflex sensitivity (BRS), an index that indicates heart rate (HR) changes to blood pressure (BP) alterations, and which is a significant measure for evaluating long-term cardiovascular changes induced by OSA. BRS can be assessed from BP and HR changes during an autonomic challenge task such as handgrip (HG). In a cross-sectional study, we assessed BRS during HG in untreated OSA (OSA_un) and CPAP treated OSA (CPAP), together with healthy control (CON) participants to determine if CPAP can recover BRS.
Methods: We collected ECG and continuous beat-by-beat BP from 95 people: 32 newly-diagnosed OSA_un (51.5±13.9years; AHI 21.0±15.3events/hour; 20male); 31 CPAP (49.4±14.0years; 22.4±14.1events/hour in initial diagnosis; 23male); and 32 CON (44.1±13.8years; 10male). We acquired data over 7 mins, during which people performed three 30s HGs (60 s baseline, 90 s recovery, 80% maximum strength). We calculated BRS over the 7 min period using sequence analysis in AcqKnowledge 5.0 BRS, followed by group comparisons using ANOVA. We also analyzed BP, HR and their variabilities: BPV and HRV (sympathetic-vagal).
Results: Mean arterial BP increases during HG were similar in all groups, although baseline mean arterial BP was higher in OSA_unc and CPAP, relative to CON (p < 0.05; OSA_un:mean±std, 90±11mmHg;

CPAP: 88±10mmHg; CON 82±13mmHg). BRS was lower in OSA_un and CPAP, relative to CON ($p < 0.05$; OSA_un: 13.1±7.6 ms/mmHg; CPAP: 13.7±9.0 ms/mmHg; control 18.3±11.9 ms/mmHg). Other cardiovascular measures of BPV, HR and HRV in addition to BP showed significant increases in response to HG, but these changes were similar in all 3 groups.

Conclusion: BRS during HG was reduced in both OSA_un and CPAP compared to CON, while HG evoked similar overall changes in BP and HR in all three groups. Although CPAP reduces sympathetic tone measured as Muscle Sympathetic Nerve Activity (MSNA), BRS appears to be unaffected by the intervention. Irreversible changes in the baroreflex network may occur with OSA that are not altered with CPAP usage.

Support (if any): NR-017435, HL135562

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WHAT ARE PATIENT CHARACTERISTICS, NURSING INTERVENTIONS AND PATIENT OUTCOMES FOR PATIENTS WITH DIFFICULTY ADAPTING TO CPAP?

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Introduction: A sleep nurse clinician was added to our care team to provide situationally responsive educational, behavioral and troubleshooting interventions and case management to patients identified as high risk for untreated SDB. The objective of this study was to describe the patient characteristics, nursing interventions, and impact on CPAP usage among patients referred to the nurse-clinician.

Methods: Descriptive exploratory retrospective chart review was used to identify patient characteristics for all new patients referred; in-depth extraction was conducted for patients who had home CPAP for ≥ 1 month and experienced difficulty using CPAP. We examined: issues using CPAP, frequency and types of nursing contacts, nursing interventions and CPAP usage. Patient characteristics of those with difficulty adapting to CPAP were compared to those referred for assistance to obtain CPAP. Change in objective CPAP usage before vs after sleep nurse case management was determined when possible.

Results: 403 patients were referred, with mean (SD) age: 54.8 y (15.7), 56.1% men, RDI: 45.4 (31.4), 42.4% employed, 16.6% retired, 25% with ≥ 3 co-morbidities plus SDB. Difficulty adapting group (n = 204) had more women ($p = 0.033$), more employed ($p = 0.03$), and more insomnia ($p = 0.001$). CPAP issues included: mask (18%), ENT (14%), constraining beliefs (14%), access to treatment (12%), pressure intolerance (11%), comorbidities (11%), suboptimal usage (7%), insomnia (7%). Nursing contact: 74% subjects had ≤ 4 contacts (range: 1–16), 53% in-person, 25% telephone calls, 22% other. Nursing interventions were: educational (33%), troubleshooting (30%), behavioural (20%), liaison/coordination of care (13%), promoting self-management skills (3%). Preliminary mean CPAP usage (n = 18) improved by 40.0 (112.3) min and by 7.4 (31) % of nights used ≥ 4 hrs (p=NS; data extraction ongoing).

Conclusion: Demographic data identified women and insomnia to be significant characteristics in the difficulty adapting group. This model of care identified 2 types of interventions not previously recognized in typical interventions to promote CPAP adaptation: Liaison/coordination of care and promoting self-management skills. Some patients were able to increase their CPAP usage.

Support (if any): MUHC Nursing Research Small Grants Award was supported by the Newton Foundation and the Montreal General Hospital Foundation.

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OUTCOME OF SLEEP-WAKE PATTERN IN OBSTRUCTIVE SLEEP APNEA PATIENTS AFTER POSITIVE AIRWAY PRESSURE THERAPY USING ACTIGRAPHY.

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Introduction: The initial phase of continuous positive airway pressure (CPAP) therapy in patients with obstructive sleep apnea (OSA) may affect sleep parameters and PAP compliance. Actigraphy is a validated method using accelerometer to objectively measure sleep parameters in patients with a range of sleep disorders, including OSA, particularly to follow-up after treatment. We compare sleep parameters from actigraphy, sleep log, sleep diary, Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI), heart rate and blood pressure in OSA patients before and after CPAP therapy for 1 week.

Methods: This pilot study have been prospectively performed at Central Chest Institute of Thailand (CCIT) since June to November 2020. Adult OSA patients, diagnosed by ICSD-3 criteria and achieved optimal or good CPAP pressure titration from split-night polysomnography (PSG), were informed and consent to wear actigraphy before and after CPAP therapy each for 1 week. Clinical and sleep parameters were recorded and analyzed using Wilcoxon matched-pair signed-rank and Mann Whitney U test. P-value < 0.05 was considered to have statistical significance.

Results: All 11 OSA patients participated in this study. Most patients were male (63.6%), hypertension (54.5%) and dyslipidemia (45.4%). Means of age, body mass index (BMI), ESS, PSQI, apnea hypopnea index (AHI), nadir SpO2, and CPAP usage were 45.5 ± 15.9 years, 29.1 ± 5.2 kg/m2, 10.8 ± 3.9, 7.7 ± 2.9, 65.2 ± 37.7 events/h, 82.3 ± 10.8 % and 9.5 ± 3.1 cmH2O, respectively. Comparing before and after 1-week CPAP therapy, an average number of wake bouts ((NWB), 48.4 vs 38 events, p=0.010), ESS (11 vs 9, p=0.035) and PSQI (8 vs 4, p=0.005) were significantly decrease. Additionally, when comparing between poor and good CPAP compliance group, NWB (55.1 vs 36.3 events, p=0.036) and the difference of wake after sleep onset (WASO, 10.5 vs -0.11 min, p=0.035) were significantly decrease.

Conclusion: OSA patients treated with CPAP for 1-week experienced marked improvement in sleepiness, sleep quality and nighttime awakening.

Support (if any):

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OUTCOME OF POSITIVE AIRWAY PRESSURE THERAPY COMBINED WITH TELEMONITORING IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME.

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Introduction: The rate of positive airway pressure (PAP) adherences in obstructive sleep apnea (OSA) patients with PAP therapy has remains persistently low. Telemonitoring is a promising wireless technology to early detect of usage trouble and solve them simultaneously. We compare PAP compliance, Epworth Sleepiness Scale (ESS), Functional Outcomes of Sleep Questionnaire (FOSQ-10), Pittsburgh Sleep Quality Index (PSQI), heart rate and blood pressure in OSA patients with PAP therapy for 12 weeks between telemonitoring and protocol-based groups.
Methods: This is a prospective simple randomization (1:1) study, allocated into the telemonitoring and protocol-based groups, at Central Chest Institute of Thailand since June to November 2020. We recruited adult patients, who underwent split-night polysomnography (PSG), met diagnostic criteria of OSA by ICSD-3 and achieved optimal or good pressure. Demographics data, physiological sleep parameters and differences between groups were analyzed by using descriptive, paired t-test, and ANOVA.
Results: A total of ten OSA patients with PAP therapy were attended. Baseline characteristics between groups were compared, and it is apparent that among telemonitoring and protocol-based groups, most patients were male (60% in each group), the average age of patients were (45.60 ± 9.86 vs 41.60 ± 12.38, p = 0.588) years, body mass index (BMI) (24.66 ± 3.39 vs 30.21 ± 6.13, p = 0.114) km/m2, Epworth Sleepiness Scale (ESS) was (10.00 ± 2.92 vs 9.40 ± 3.57, p = 0.779), apnea-hypopnea index (AHI) of (60.06 ± 31.08 vs 77.98 ± 43.17, p = 0.473) events/hour, and PAP pressure usage (10.20 ± 3.71 vs 10.00 ± 3.67, p = 0.933) cmH2O. There was no significant difference between groups in clinical parameters, sleep questionnaires and PAP compliance of obstructive sleep apnea (OSA) patients with PAP therapy for 12 weeks. However, in telemonitoring group, PSQI compared among baseline, fourth and twelfth week were significantly improved (7.60 ± 2.71 vs 5.00 ± 2.00 vs 4.00 ± 1.00 respectively, p = 0.041).
Conclusion: Using telemonitoring-guided intervention causes significantly improved in Pittsburgh Sleep Quality Index in severe obstructive sleep apnea patients with PAP therapy for 12 weeks. There was no significant difference in PAP compliance between telemonitoring and protocol-based groups.
Support (if any):

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BRAIN STRUCTURE AND BAROREFLEX SENSITIVITY ASSOCIATIONS IN OBSTRUCTIVE SLEEP APNEA WITH AND WITHOUT CPAP

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Introduction: Obstructive sleep apnea (OSA) disrupts multiple aspects of autonomic regulation; it is unclear whether intervention with continuous positive airway pressure (CPAP) can correct such disruptions. One key index of autonomic regulation is baroreflex sensitivity (BRS), an index that indicates heart rate (HR) changes to blood pressure (BP) alterations, and which is a significant measure for evaluating long-term cardiovascular changes induced by OSA. BRS can be assessed from BP and HR changes during an autonomic challenge task such as handgrip (HG). In a cross-sectional study, we assessed BRS during HG in untreated OSA (OSA_un) and CPAP treated OSA (CPAP), together with healthy control (CON) participants to determine if CPAP can recover BRS.
Methods: We collected ECG and continuous beat-by-beat BP from 95 people: 32 newly-diagnosed OSA_un (51.5±13.9years; AHI 21.0±15.3events/hour; 20male); 31 CPAP (49.4±14.0years; 22.4±14.1events/hour in initial diagnosis; 23male); and 32 CON (44.1±13.8years; 10male). We acquired data over 7 mins, during which people performed three 30s HGs (60 s baseline, 90 s recovery, 80% maximum strength). We calculated BRS over the 7 min period using sequence analysis in AcqKnowledge 5.0 BRS, followed by group comparisons using ANOVA. We also analyzed BP, HR, and their variabilities: BPV and HRV (sympathetic-vagal).
Results: Mean arterial BP increases during HG were similar in all groups, although baseline mean arterial BP was higher in OSA_unc and CPAP, relative to CON ($p < 0.05$; OSA_un:mean±std, 90±11mmHg; CPAP: 88±10mmHg; CON 82±13mmHg). BRS was lower in OSA_un and CPAP, relative to CON ($p < 0.05$; OSA_un: 13.1±7.6 ms/mmHg; CPAP: 13.7±9.0 ms/mmHg; control 18.3±11.9 ms/mmHg). Other cardiovascular measures of BPV, HR, and HRV in addition to BP showed significant increases in response to HG, but these changes were similar in all 3 groups.
Conclusion: BRS during HG was reduced in both OSA_un and CPAP compared to CON, while HG evoked similar overall changes in BP and HR in all three groups. Although CPAP reduces sympathetic tone measured as Muscle Sympathetic Nerve Activity (MSNA), BRS appears to be unaffected by the intervention. Irreversible changes in the baroreflex network may occur with OSA that are not altered with CPAP usage.
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INSOMNIA AND RESTLESS LEGS SYNDROME IN PATIENTS WITH UPPER AIRWAY STIMULATION THERAPY

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Introduction: Insomnia and restless legs syndrome (RLS) are common sleep disorders that may impact obstructive sleep apnea (OSA) treatment. To our knowledge, no studies have investigated whether these comorbidities affect upper airway stimulation (UAS) therapy adherence and outcomes. This study aims to explore possible effects of insomnia and RLS in patients using UAS therapy.
Methods: All patients who underwent UAS system implantation for treatment of OSA at our facility were retrospectively studied. Pre- and post-implant histories and data, including diagnostic sleep testing, otolaryngology evaluation, activation results, and treatment evaluation, were analyzed. Patients with no insomnia or RLS were compared to patients with insomnia, RLS, or both. Apnea-hypopnea index (AHI), Epworth Sleepiness Scale (ESS), and adherence were compared pre- and post-treatment for each group.
Results: Sixty-four patients who have undergone UAS implantation at our center have completed post-treatment in-lab titration and evaluation of their UAS system. Insomnia was present in 47%, RLS in 28%, and both insomnia and RLS in 14%. In all groups, the overall AHI during in-lab titration was >50% lower than the pre-treatment AHI (16.1+/-14.3/h vs 32.5+/-13.1/h, $p<0.001$). While the trend in AHI reductions suggested a lower AHI in those without insomnia or RLS, the reduction did not reach statistical significance (no insomnia or RLS 15.7+/-12.9/h, insomnia 16.9+/-16.7/h, RLS 19.0+/-15.5/h, both insomnia and RLS 23.4+/-18.4/h). UAS therapy usage was reduced in patients with RLS (3.9+/-2.6 h/night, $p=0.029$) and in patients with both insomnia and RLS (3.9+/-1.3 h/night, $p=0.046$) compared to patients with neither comorbidity (5.9+/-1.9 h/night). Mean reduction in ESS was similar across groups, averaging from 11+/-5 pre-treatment to 7+/-5 post-treatment ($p<0.001$).

Conclusion: Insomnia and RLS are common in patients using UAS therapy for OSA. Pre- and post-treatment residual AHI and ESS significantly improved in all patient groups assessed. A decrease in UAS usage was present in patients with RLS and both RLS and insomnia. Our study suggests that identification and treatment of RLS and insomnia may play an important role for UAS therapy adherence and efficacy, thus, optimizing care.
Support (if any):

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PRECISION ORAL APPLIANCE THERAPY: THE PRIME-TIME TREATMENT FOR OSA

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Introduction: CPAP was previously considered the "gold standard" due to its high efficacy in eliminating obstructive events. Despite improvements in technology, the "effectiveness" of CPAP has been compromised by poor real-world compliance. Technological improvements have improved the "effectiveness" of Oral Appliances. This study reports the efficacy of a novel, precision engineered Oral Appliance for the primary treatment of all severities of OSA.
Methods: Digital scans and digital bite registrations were recorded with a George Gauge utilizing a a 3mm bite fork. Initial protrusion was set at 40–60% and varied according to the degree of overbite and overjet, the severity of OSA, and the presence or absence of TMJ symptoms. All patients were fitted with a ProSomnus (IA) MAD and titrated according to their subjective symptoms. An efficacy study was obtained with a HST after titration and compared to the initial PSG or HST.
Results: Outcome data on 85 patients (37 female, 48 males, aged 56.7 +/1 10.2 years) was retrospectively reviewed. The patients were consecutively ordered for follow up data, many patients did not return for follow ups. The pre-treatment AHI was 24.5 +/- 19.1 with 36 patients Mild, 26 Moderate and 23 Severe patients. O2 Nadir was 84.1% +/- 5.5%. Post treatment AHI was 5.5 +/- 4.9 with an AHI reduction of 71.6% +/- 20.3%. 59% of the patients scored <5, 31% 10 on the outcome AHI data. O2 Nadir improved to 88.2% overall. 31 patients had RERA's (RDI-AHI) >10 with an average of 16.7 +/- 7.5, of these patients 27 saw a reduction of RERA's of 54.4% from 16.9 to 7.1.
Conclusion: The data shows that a precision oral appliance is capable of successfully treating patients with all levels of severity, with the majority of patients treated to an AHI<5. 23 severe patients with an average AHI of 49.7 were treated to a final average of 8.6, 4 of the patients scored above 10. Additionally, patients successfully saw a reduction in upper airway resistance airflow as evidenced by a reduction of RERA's of 54.5%, showing that a precision oral appliance can have a significant impact on the upper airway.
Support (if any): None

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SINGLE SESSION CBT TO IMPROVE PAP INITIATION AND ADHERENCE AMONG VETERANS WITH OSA

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Introduction: Obstructive sleep apnea (OSA) is a condition that is prevalent, pernicious, and linked to the development and exacerbation of several disease processes. Positive airway pressure (PAP) is a highly efficacious intervention; however, initiation and adherence rates are poor. This represents a critical gap in care and a missed opportunity to reduce morbidity and mortality associated with OSA. The present study piloted a single session of cognitive behavioral therapy for treatment seeking (CBT-TS) among veterans diagnosed with obstructive sleep apnea and newly prescribed PAP.
Methods: Participants were asked to complete assessments at baseline and at two- and four-weeks post-intervention. A sample of 40 Veterans were enrolled in the study and completed a baseline interview, 27 completed CBT-TS. A matched comparison group of 64 veterans who did not receive the intervention was constructed using electronic medical record and PAP adherence data. Mann Whitney U and Chi Square tests were used to examine group differences in initiation and adherence.
Results: Participants who completed the CBT-TS session were more likely to initiate PAP (at least 3 consecutive nights of use) as compared to those receiving treatment as usual (TAU) [(CBT-TS; 96.3%; 26/27) versus (TAU; 64.1%; 41/64); X2(1, N = 91) = 10.16, p = .001]. Participants in the CBT-TS group also used their PAP devices for a greater number of nights over the first month than the comparison group [(CBT-TS; M = 21.7 (SD = 8.9), Mdn = 26.0) versus (TAU; M = 14.4 (SD = 12.6), Mdn = 15.5); U = 555.0, p = .007] and were more likely to use the device in an adherent manner (i.e., ≥4 hours use in an evening); [(CBT-TS; M = 15.1 (SD = 11.2); Mdn = 15.0) versus (TAU; M = 10.3 (SD = 11.2), Mdn = 6.5); U =630.0, p = .038].
Conclusion: These preliminary data suggest that CBT-TS may have utility in increasing initiation of PAP and subsequent treatment adherence among Veterans diagnosed with OSA and newly prescribed PAP.
Support (if any): This work was supported by the VA Center of Excellence for Suicide Prevention in the Finger Lakes Healthcare System.

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OBSTRUCTIVE SLEEP APNEA TREATMENT (E.G., CPAP) DIFFERENTIAL EFFECTS ON COGNITIVE PERFORMANCE

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Introduction: The efficacy of CPAP treatment for cognitive improvement among patients with OSA is inconsistent. Naegele et al. (1995) found that short term memory impairment persisted even after 4 to 6 months of CPAP; O'Donoghue et al. (2012) have reported they did not find improvement in vigilance or memory; Felver-Grant (2007) found that working memory improved but not other cognitive tests. Kanbay et al. (2015) found patients improved on the MMSE scores after 3 months of CPAP treatment. Kim et al. (2018) claimed just 3 weeks of CPAP treatment improved attention, sleep quality, and excessive daytime sleepiness (EDS). CPAP therapy has little effect on the improvement of cognitive deficits associated with OSA if the patients did not complain of daytime sleepiness (Zhou et al,, 2016).
Methods: Both untreated OSA patients (N=19) and ApneaLinkTM-screened controls (N=16) were administered a battery of cognitive tests before the patients started using CPAP and these two conditions were tested again after 3 months of CPAP treatment. A Fisher's Exact Chi-Square test was used to determine if there was an association between conditions (OSA patients vs. Controls) and level of performance on cognitive tests (low vs. high scores) at the baseline and after 3 months of treatment.

Results: Depression scores, subjective sleep quality scores (global PSQI), EDS scores (Epworth Sleepiness Scale), and mood disturbance (Profile of Mood States) decreased after 3 months of CPAP treatment just for patients. Controls (individuals without moderate or severe OSA) performed better at the second time on phonemic fluency, immediate recall memory test, and 30 minute delayed memory recall test.
Conclusion: The fact that patients did not do better at time 2 on any of the cognitive tests may indicate a long term effect of hypoxia on the brain. The cognitive deficits may not reverse within the first 3 months of CPAP although self-reported depressive symptoms and perception of sleep quality and positive mood have improved when patients reported they are compliant with the treatment.
Support (if any): A grant from the Center for Integrative Research on Cognitive Neural Science, Southern Illinois University Carbondale was received.

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EFFICACY OF A NOVEL ORAL APPLIANCE AND THE INFLUENCE OF OSA PATHOPHYSIOLOGICAL TRAITS ON TREATMENT RESPONSE

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Introduction: Oral appliance therapy is a recommended alternative to CPAP for OSA. Approximately 50% of patients have a major reduction in OSA severity but successful treatment outcome remains challenging to predict. Previous prediction methods have focused on clinical variables which have poor predictive value. OSA is recognised as a heterogenous disorder caused by 4 pathophysiological traits. The influence of OSA pathophysiological traits on oral appliance treatment outcome has been explored in recent physiological studies using simplified phenotyping methods. In this preliminary report, we prospectively compared differences in the 4 OSA phenotypes between responders and incomplete responders to a novel oral appliance with built in oral airway using gold standard phenotyping methodology.
Methods: Data from 22 people with OSA (AHI>10events/h) have been analysed to date. A diagnostic in-laboratory PSG was initially conducted to confirm OSA. A detailed physiology PSG was carried out prior to commencement of oral appliance therapy. For this study night participants were instrumented with standard PSG equipment, nasal mask, pneumotachograph, epiglottic pressure catheter and intramuscular electrodes inserted perorally into the genioglossus to quantify baseline OSA phenotypic traits. Pcrit was quantified via CPAP dial downs and the non-anatomical traits were quantified from naturally occurring apneas and hypopneas. Participants were then fitted with a next generation novel oral appliance with a built-in oral airway (Oventus O2Vent Optima™) and titrated to at least 75% of maximum mandibular advancement. After acclimatization to therapy, participants were invited to undergo a treatment efficacy PSG.
Results: Oral appliance therapy reduced the AHI by 52% (21[15,31] vs. 11[7,16] events/h, p<0.001). 46% of participants responded to oral appliance therapy based on the definition of AHI < 10events/h. Preliminary analyses indicated that estimates of baseline upper airway collapsibility tended to be different in responders versus non-responders (responders have less collapsible airways).
Conclusion: The novel oral appliance reduced OSA severity by 50% with resolution of OSA in half of participants. Baseline pharyngeal collapsibility may be an important physiological predictor of treatment outcome.
Support (if any):

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RAPID EYE MOVEMENT REBOUND AFTER CONTINUOUS POSITIVE AIRWAY PRESSURE IN CO-MORBID OBSTRUCTIVE SLEEP APNEA AND FIBROMYALGIA

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Introduction: Fibromyalgia (FM) is a chronic pain condition that is associated with poor sleep quality and may present with obstructive sleep apnea (OSA). In OSA patients without FM, previous research has demonstrated a 57% relative increase in rapid eye movement (REM) sleep duration following treatment with continuous positive airway pressure (CPAP). However, there is limited data on REM rebound in patients with co-morbid FM and OSA. Patients with FM are often prescribed medication, like opioid analgesics, that decrease REM sleep. Additionally, pain perception may be altered by decreased REM duration. In the context of a national opioid crisis, it is imperative to explore how nonpharmacological options for treatment of co-morbid FM and OSA may improve REM sleep duration.
Methods: Following IRB approval at a university-affiliated teaching hospital, an electronic medical chart review was completed on patients diagnosed with FM and OSA who received polysomnography testing (PSG) and subsequent CPAP titration treatment. REM duration and REM total sleep time (TST) percentages were reviewed at baseline PSG and after CPAP titration.
Results: FM with OSA (n = 30). Mean age: 50.87, female: 28 (93%), male: 2 (7%). Baseline PSG: mean REM duration 34.47 minutes, mean REM TST 11.03%. After CPAP titration: mean REM duration 56.78 minutes, mean REM TST 18.84%. Pre- and post-CPAP titration REM TST percentage increased from 11.0% to 18.8%, indicating a mean difference of 7.8% ($p < 0.001$) and a 71% relative increase in REM TST percentage duration.
Conclusion: These findings suggest delivery of CPAP to patients with FM and OSA improved REM sleep duration. The role of sleep in FM and pain severity is underexplored. Given the potential of chronic opioid use in patients with FM, treatment of OSA with CPAP may be a nonpharmacological alternative to pain management. Future studies are needed to see if REM rebound is associated with wellbeing, including perceived sleep quality and decreased pain perception.
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CONTINUOUS POSITIVE AIRWAY PRESSURE AND CARDIOVASCULAR RISK IN A LARGE CLINICAL SAMPLE OF OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: While studies support the beneficial short-term role of continuous positive airway pressure (CPAP) therapy on cardiometabolic risk in adults with obstructive sleep apnea (OSA), its sustained effect on cardiovascular disease (CVD) risk is unknown. CPAP use data linked to electronic health records (EHR) offer opportunities to understand the role of OSA treatment for preventing CVD. We evaluated the

association between CPAP use and CVD incidence in patients referred to a sleep study at a large health system.

Methods: We included adult patients with available apnea-hypopnea index (AHI) between 01/2018-02/2020 in Kaiser Permanente Southern California. At baseline, eligible participants had >1 year of continuous insurance coverage allowing gaps <90 days and were free of CVD 1 year prior to OSA diagnosis. Participants were distributed into three groups: no OSA (AHI<5), OSA (AHI≥5) with any CPAP use (median[IQR] 2.5[0.7–5.0] h/day) and OSA without evidence of CPAP use. CVD incidence was defined as first occurrence of myocardial infarction, stroke, unstable angina, heart failure or CVD death, based on validated EHR algorithms. We used Cox proportional hazards models to assess the association between OSA with or without CPAP use and CVD incidence, adjusted for baseline age, sex, body mass index, race/ethnicity, Charlson comorbidity index, and use of anti-hypertensives and lipid-lowering medications. Stratified analyses were conducted based on OSA severity.

Results: We included 11,145 patients without OSA, 13,898 with OSA and CPAP use, and 20,884 patients without CPAP use. Median follow-up was 262 days (IQR=129–409). CVD incidence rates were, respectively, 0.26%, 0.45% and 0.56%. In adjusted models, moderate-severe OSA (AHI≥15) without CPAP use was associated with increased CVD incidence when compared to no OSA (HR=1.71; 95%CI=1.11–2.64; p=0.016). OSA with any CPAP use was associated with lower CVD incidence (HR=0.68; 95%CI=0.50–0.93; p=0.016) when compared to OSA patients with no CPAP use. Stronger effects were observed when restricting the sample to moderate-severe OSA (HR=0.56; 95%CI=0.39–0.81; p=0.002).

Conclusion: Our analysis in a large observational clinical sample suggests that moderate-severe OSA with no CPAP use is associated with increased CVD incidence. Moreover, OSA with CPAP use was associated with decreased CVD incidence relative to no CPAP use.

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A MULTI-CENTER PREFERENCE STUDY OF A NOVEL ORAL APPLIANCE DESIGN AND MATERIAL

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Introduction: AASM guidelines for OAT advise sleep medicine physicians to consider patient preference when determining the treatment modality for mild and moderate OSA. This investigation evaluates patient preference for a novel OAT device in comparison with CPAP and other legacy OAT devices.

Methods: A novel OA (ProSomnus EVOTM, Pleasanton, CA) was manufactured from digital records of U/L impressions and bite registrations. 31 Patients (all with one or more legacy OAs and 20 previous CPAP users) across 7 dentists were surveyed regarding preferences of this novel OA using a 0–10 scale. Samples were analyzed for stainability by mustard at 37C for 10 days against representative predicates using colorimetry.

Results: Patient Survey 100% Preferred the novel OA over CPAP, would wear it and easier to clean and preferred over their previous appliance This novel OA was comfortable and smaller 9.3 Easier to close my lips together 8.8 Confident in device durability/will not break 9.1 No crowns were removed/damaged Dentists Survey 81% no adjustment interventions for fit at delivery, average adjustment time was 3.1 min. 100% Would prescribe this novel OA again and recommend to colleagues This novel OA was easier to deliver than other devices 9.1 Retention was just right at delivery 8.9 Would use this novel OA on wider range of patients 9.8 This monolithic novel OA would be easy to keep clean 9.8 Stain Testing in □E from Colorimetry Milled PMMA 3.06 Milled novel OA 3.20 CPAP Mask plastic 7.54 Milled PMMA w/soft Liner/Fulcrum Strap 8.27 CPAP Mask silicone 11.60 PMMA +Liner Anterior Hook 19.05 PMMA with Liner Herbst 32.05 Nylon/Airway 90.70 Nylon/Strap 96.99

Conclusion: Patients preferred this novel OA over CPAP and all other devices similarly designed for comfortable easy fit and delivery (soft liners and printed nylon) without compromising the comfort, cleanability or strength. Liner-less milled devices outperform all other devices with less staining. Color stability from mustard was significantly better for the milled PMMA and this Novel OA materials than all other combinations

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INFLUENCE OF CHRONOTYPE ON CPAP ADHERENCE

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Introduction: Continuous positive airway pressure therapy (CPAP) is an efficacious treatment for obstructive sleep apnea (OSA). However, despite interventions targeting established determinants of CPAP use, adherence to CPAP remains poor. An Individual's chronotype can influence behavior including adherence to dietary changes and alcohol abstinence. We hypothesized that chronotype will be associated with CPAP adherence and aimed to identify the mechanisms of this association.

Methods: Secondary data analysis of the active CPAP arm (n=469) from the Apnea Positive Pressure Long-term Efficacy Study, a multicenter randomized controlled trial of CPAP therapy in a sleep clinic population was performed. The Morningness-Eveningness Questionnaire (MEQ) was used to identify three chronotype categories: Evening (MEQ score: 16–41), Neither (42–58) and Morning (59–86) types. CPAP adherence over 6-months (hours/night) was objectively measured using smart-card downloads. Linear mixed modelling evaluated the association between the chronotype and CPAP adherence, adjusting for confounders (e.g., age). Mechanisms of this association were examined by change in beta estimates for the chronotype with addition of a potential mediator (e.g., sleep duration).

Results: There were 206(44%), 38(8%) and 219(47%) Morning, Evening and Neither chronotype patients respectively. Evening types were youngest (48.0±13.4 vs. 50.3±11.3 and 56.3±11.4 years, p<0.001) with highest body mass index (BMI, 34.9±10.5 vs. 31.2±10.5 and 32.7±10.5 kg/m2, p=0.006) and longest sleep on weekends (7.9±2.0 vs. 7.3±1.3 and 7.6±1.5 hours, p=0.017) compared to Morning and Neither types. A higher proportion of Evening types also reported symptoms of insomnia and fatigue (p-values 0.017 and 0.048 respectively). CPAP adherence, however, did not differ between Evening and Neither types (p=0.276). Compared to the Neither types, Morning types exhibited significantly higher CPAP adherence (β= 40mins/night, p=0.001) with a slight decrease after adjusting for age, sex, race, marital status, education, and OSA severity (β= 33mins/night, p=0.012). Sleep duration, insomnia, BMI and fatigue mediated a minimal proportion of this effect (0.7–3.7%).

Conclusion: In this cohort of sleep clinic patients, the Morning chronotype was associated with better CPAP adherence. Only a small

proportion of this association was mediated by observed clinical differences between the chronotypes. Understanding the influence of chronotype on CPAP use may provide novel insight for improving OSA therapy effectiveness.

Support (if any):

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FEASIBILITY OF A SLEEP TECHNOLOGIST DRIVEN INTERVENTION PROTOCOL TO ADDRESS CPAP ADHERENCE IN HOSPITALIZED PATIENTS

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Introduction: Obstructive sleep apnea (OSA) is associated with development of high blood pressure, diabetes, pulmonary hypertension, heart attack, stroke, atrial fibrillation, motor vehicle accidents, and death. These comorbidities may result in hospital admissions. Much of the therapy has been directed towards outpatient treatment with CPAP. Unfortunately, patient adherence to CPAP therapy is not optimal. We conducted a feasibility study to determine if a sleep technologist driven intervention protocol could address CPAP adherence in hospitalized patients.

Methods: Tampa General Hospital Sleep Center developed a quality improvement protocol that would address inadequate CPAP adherence. The components include: 1. Education on the cause and need for treatment of OSA based on comorbidities, 2. Choosing a patient preferred mask, 3. Mask desensitization while awake. These criteria were used to test the feasibility of implementing this protocol in hospitalized patients: 1. Completion of the protocol within 48 hours of receiving a consult, 2. Implementation of various components of the protocol, 3. Obtaining outcome measures to evaluate efficacy. Outcome measures include patient willingness to retry CPAP (on a scale from 0–10) and CPAP smartcard download. Additional outcome data included: patient reasoning for CPAP noncompliance and self-administered questionnaires (ESS, ISI, GAD-7, PHQ-9, SF-26).

Results: During November 2020, 31 inpatient consults were placed to the TGH Sleep Center. Within 48 hours of consult, the technologists implemented the protocol in 19 patients – 17 received mask fittings, 3 received education, and 3 had CPAP setting adjustments. 9 patients indicated their willingness to retry CPAP with an average rating of 9.1. 7 compliance downloads were obtained the following morning and usage ranged from 0:52 to 11:07 hours. 12 consults were not completed due to not meeting inclusion criteria (5), patient refusal (4), or other reasons (3).

Conclusion: This study demonstrates feasibility of a sleep technologist driven intervention protocol to address CPAP adherence in hospitalized patients. However, there were inconsistencies in protocol execution and obtaining outcome measures. We speculate that protocol improvement will require: 1. More consistent patient education, 2. Better correction of patient specific adherence issues, 3. Obtaining all smartcard downloads, 4. Compiling outcome measures using a convenient digital interface.

Support (if any):

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INTERVENTION AMONG PAP USERS NEWLY DIAGNOSED WITH OSA IMPROVES LONG-TERM ADHERENCE IN VETERANS WITH SLEEP APNEA AND PTSD

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Introduction: Obstructive sleep apnea (OSA) and PTSD are commonly comorbid in veterans. While PAP is the first line treatment for sleep apnea, adherence is low among veterans (Collen et al, 2012). Studies have shown early adherence predicts later adherence (Budhiraja et al, 2007). The current study investigates the impact of intervention on PAP adherence over time.

Methods: Thirty-seven veterans with comorbid OSA and PTSD from VA Palo Alto clinics were randomly assigned to either cognitive behavioral therapy (CBT-OSA) or an education arm and also received usual treatment at VA or outside clinics. Twenty-six completed the study. Participants received weekly, individual visits during the first four weeks of PAP treatment, three subsequent quarterly booster sessions, and a final visit at 12 months. PAP data was downloaded at each timepoint; prior PAP use was coded.

Results: Significant mean differences in mask-on time between treatment arms after weekly treatments (Kinoshita et al., 2020) were not maintained at 12 months. Linear mixed modeling showed weekly improvement in mean mask-on time (minutes) over the treatment period (Education: estimate = 13.7, SE = 3.2, 95% CI 7.3, 20.1; CBT-OSA: estimate = 11.4, SE = 3.6, 95% CI 4.3, 18.5); no significant difference between arms (estimate = -2.3, SE = 4.7, 95% CI -11.5, 6.9). Newly diagnosed participants had significantly higher mean mask-on time than prior-PAP users at the end of weekly treatments ($F[1, 35] = 17.86$, $p < 0.001$) and at 12-months ($F[1, 24] = 19.60$, $p < 0.001$). Average mask-on time following weekly treatments was significantly correlated with average mask-on time at 12-months ($r = 0.75$; $p < 0.001$).

Conclusion: Consistent with prior research, findings suggest that newly diagnosed individuals benefit from weekly individual treatments, regardless of type, and maintain higher mask-on times at 12 months relative to prior PAP users. Early intervention when starting PAP treatment is important to support adherence, especially in patients with comorbid PTSD, a barrier to adherence in the veteran population.

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ENHANCING PAP COMPLIANCE EFFICACY WITH EARLY CLOSER FOLLOW-UPS (2–3 DAYS VS OTHERS): A RETROSPECTIVE SINGLE-CENTRE REVIEW

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Introduction: PAP is an effective gold standard for OSA treatment; however, compliance remains an issue. Centre for Medicare defines compliance as PAP usage of ≥4hrs daily and ≥70% in a 30-day period.

This study aimed at evaluating the effectiveness of early patient-centred follow-ups (2–3 days mandatory versus 4 weeks mandatory and/or as needed basis).

Methods: Retrospective data analysis of 100 consecutive patients (≥18 years) over a year in an interrupted time series with pre-test (Group1) and post-test (Group2) of 50 patients each. All patients included were symptomatic (ESS ≥10), CPAP naive, diagnosed with OSA, and diagnostic AHI ≥5. All received a post diagnostic sleep questionnaire assessing their overall quality of sleep with PAP therapy. Therapeutic AHI was collected from updated 90-day compliance report thru web enabled online RESMED AIRVIEW's secure database. Initial follow-up for Group1 was in 4 weeks and/or earlier if patient initiated and for Group2 in 2–3 days following PAP set up. Additionally, non-compliant patients in Group2 received monthly follow-ups.

Results: Following findings were reported for Group1 - (Male=24, Female=26), mean age 65.79±13.21, and BMI 36.12±7.50; and Group2 - (Male=25, Female=25), mean age 62.8±12.32, and BMI 36.90±9.29. During diagnostic testing >50% patients in both groups rated their overall sleep to be worse than usual. Compliance for Group1 was significantly worst than Group2 (64% and 91%, respectively). Group1 had 8=AHI≥5, 29=AHI≤5 and had 13 lost to followup (11 behavioural in-adaptations, 2 financial constrains) soon after commencing CPAP. Group2 had 3 lost to financial constraints, 4=AHI≥5, and 43=AHI<5. Chi-square (5.4265) indicated p-value=.019, chi-square Yates-correction (4.502) calculated p-value=.033. Significant at p<.05, Chi-square test revealed dependant relationship between PAP unsatisfactory patient evaluation during diagnostic polysomnography to PAP non-compliance. Group1's RR=3 and OR=4.45; Group2's RR=0.33 and OR=0.22, indicated higher probability of non-compliance in Group1.

Conclusion: Provider-patient contact within 2–3 days versus any other intervals (4 weeks mandatory and/or as needed in this case), soon after commencing PAP therapy not only increases compliance efficacy but also reduces patient dropouts and anxiety with PAP therapy. Considerable fraction of patients are uncomfortable using CPAP; therefore, closer follow-ups versus 4 weeks is warranted to maintain CPAP adherence.

Support (if any):

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PREDICTORS OF THE ACCURACY OF POSITIVE PRESSURE THERAPY MACHINE-DETECTED APNEA-HYPOPNEA EVENTS

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Introduction: During positive airway pressure (PAP) therapy for sleep apnea syndromes, the machine detected apnea hypopnea index (AHI) is an important method for clinicians to evaluate the beneficial effects of PAP. There are concerns about the accuracy of this detection, which also confounds a related question-how common and severe are residual events on PAP. Our study aimed for estimating the long term accuracy of machine detected AHI and the predictors.

Methods: Subjects with OSA who underwent a split night polysomnography were recruited prospectively. Those treated with PAP and tracked by the EncoreAnywhereTM system were analyzed. The ones who stopped PAP within one month were excluded for this analysis. Compliance, therapy data and waveform data were analyzed. Machine detected versus manually scored events were compared at the 1st, 3rd, 6th and 12th month from PAP initiation, and logistic regression was done to explore the factors associated with a high AHI difference.

Results: One hundred and seventy-two patients with mean age of 58.79 ± 13.80 and 63.4% male were included. The differences between the machine detected AHI and manual scored AHI was 10.72 ±8.43 in the first month and were stable for up to 12 months. Male sex, large leak ≥ 1.5% of the whole night, titration arousal index ≥ 15 times/hour, and higher ratio of unstable breathing were associated with AHI difference ≥ 5 times/hour.

Conclusion: The limited agreement between machine detected AHI in the tracking system and manually scored AHI persists for up to 12 months. Gender, large leak, the amount of unstable breathing on PAP, and arousal index during the titration were factors associated with this inaccuracy.

Support (if any): positive airway pressure, apnea hypopnea index; detection accuracy

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ACUTE EFFECT OF ACETAZOLAMIDE IN HIGH LOOP GAIN SLEEP APNEA

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Introduction: Obstructive sleep apnea is a disease with different driver phenotypes, including high loop gain (HLG). Acetazolamide (AZT) reduces HLG through multiple mechanisms. The acute effect of AZT used during titration polysomnography in HLG sleep apnea (HLGSA, predominantly obstructive) is described here. HLGSA is a NREM-dominant disease.

Methods: HLGSA was identified by one or more of the following: 1) baseline or titration CAHI of 5 or more, baseline or titration periodic breathing, or high residual apnea on CPAP in the absence of large leak. Retrospective analysis of polysomnograms from patients with HLGSA who underwent a PAP titration study and took ATZ (125 or 250 mg) after a baseline component of PAP titration. A responder was defined as a minimum reduction of the AHI3% of 50%. Multivariable logistic regression model estimated responder predictors.

Results: Two hundred and thirty-six patients with a median age of 60 (50.25–68) years and 189 (80.1%) males, were included. 69 patients were given 125 mg ATZ and 157 patients took 250 mg after about 3 hours of initial drug-free titration. Compared to PAP alone, PAP plus ATZ reduced the breathing related arousal index (8.45[3.03–15.60] vs. 4.8[2.1–10.15], p<0.001), AHI3% (19.09[7.34–37.28] vs. 10.63[4.46–20.56], p<0.001), AHI4% (1.89[0.23–8.58] vs. 1.19 [0.42–4.70], p=0.001), RDI (24.01[10.55–41.46] vs. 13.55[7.24–25.66], p<0.001). ATZ minimally improved the Min SpO2 (90[87–92] vs. 91[88–92], p=0.014). 101 patients were responders. Multiple logistic regression analysis showed that the NREM AHI3% was the only predictor for responder status with ATZ exposure (OR 1.022, 95%CI [1.004–1.041], p=0.018)

Conclusion: ATZ acutely improves PAP efficacy in HLGSA. The NREM AHI3% is a predictor for the ATZ responders.

Support (if any): This study was supported by American Academy of Sleep Medicine Foundation, category-I award to RJT

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COST-EFFECTIVENESS OF A 3-YEAR TELE-OSA INTERVENTION

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Introduction: Trial-based tele-obstructive sleep apnea (OSA) cost-effectiveness analyses have often been inconclusive due to small sample sizes and short follow-up. In this study, we report the cost-effectiveness of Tele-OSA using a larger sample from a 3-month trial that was augmented with 2.75 additional years of epidemiologic follow-up.

Methods: The Tele-OSA study was a 3-month randomized trial conducted in Kaiser Permanente Southern California that demonstrated improved adherence in patients receiving automated feedback messaging regarding their positive airway pressure (PAP) use when compared to usual care. At the end of the 3 months, participants in the intervention group pseudo-randomly either stopped or continued receiving messaging. This analysis included those participants who had moderate-severe OSA (Apnea Hypopnea Index >=15) and compared the cost-effectiveness of 3 groups: 1) no messaging, 2) messaging for 3 months only, and 3) messaging for 3 years. Costs were derived by multiplying medical service use from electronic medical records times costs from Federal fee schedules. Effects were average nightly hours of PAP use. We report the incremental cost per incremental hour of PAP use as well as the fraction acceptable.

Results: We included 256 patients with moderate-severe OSA (Group 1, n=132; Group 2, n=79; Group 3, n=45). Group 2, which received the intervention for 3 months only, had the highest costs and fewest hours of use and was dominated by the other two groups. Average 1-year costs for groups 1 and 3 were $6035 (SE, $477) and $6154 (SE, $575), respectively; average nightly hours of PAP use were 3.07 (SE, 0.23) and 4.09 (SE, 0.42). Compared to no messaging, messaging for 3 years had an incremental cost ($119, p=0.86) per incremental hour of use (1.02, p=0.03) of $117. For a willingness-to-pay (WTP) of $500 per year ($1.37/night), 3-year messaging has a 70% chance of being acceptable.

Conclusion: Long-term Tele-OSA messaging was more effective than no messaging for PAP use outcomes but also highly likely cost-effective with an acceptable willingness-to-pay threshold. Epidemiologic evidence suggests that this greater use will yield both clinical and additional economic benefits.

Support (if any): Tele-OSA study was supported by the AASM Foundation SRA Grant #: 104-SR-13

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ASSOCIATION BETWEEN POSITIVE AIRWAY PRESSURE ADHERENCE AND HEALTHCARE COSTS

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Introduction: The impact of positive airway pressure (PAP) therapy for obstructive sleep apnea (OSA) on healthcare costs is uncertain. We explored the relationship between 3-year PAP adherence and direct healthcare cost utilizing the Tele-OSA study cohort.

Methods: The Tele-OSA randomized clinical trial demonstrated improved PAP adherence in patients receiving automated feedback messaging regarding their PAP use versus usual care. The study enrolled patients at Kaiser Permanente Southern California, a large integrated healthcare system, from 2014–2015. Patients with moderate-severe OSA (Apnea Hypopnea Index [AHI] ≥15) from all study arms were consolidated, then stratified into PAP adherence groups based on mean PAP hours and PAP use patterns over 3-year follow-up period: (a) high adherence (consistent ≥4 hours/night); (b) moderate adherence (2–3.9 hours/night or inconsistent ≥4 hours/night); (c) low adherence (<2 hours/night). Healthcare costs (2020 US dollars) were derived by assigning costs from Federal fee schedules to healthcare utilization extracted from electronic health records. The 6-month mean healthcare costs during follow-up were estimated using generalized linear models adjusting for patient demographics, comorbidities, Medicaid coverage, prior healthcare cost, and AHI.

Results: Of 374 patients (mean age 50 years, 63% male), 22% were categorized into high adherence, 18% moderate adherence, and 60% low adherence to PAP therapy. Mean (SD) hours of PAP use were 6.5 (1.1) hours, 3.7 (1.3) hours, and 0.3 (0.5) hours for high, moderate, and low adherence groups, respectively. The high adherence group had the lowest average (SE) adjusted 6-month healthcare costs compared with other groups (High: $2,991 [$234]; Moderate: $3,604 [$412]; Low: $3,854 [$300]). Cost savings of high vs low adherence were $862 (95% CI $1540, $185). Cost savings of moderate vs low adherence were $250 (95% CI -$694, $1,193).

Conclusion: Better PAP adherence was associated with significantly lower healthcare costs over 3 years in patients with moderate-severe OSA. Findings support the importance of care strategies to enhance long-term PAP adherence for OSA therapy.

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THE EFFECTS OF POSITIONAL AND SLEEP STAGE DEPENDENCY ON MANDIBULAR ADVANCEMENT DEVICE TREATMENT OUTCOME IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Mandibular advancement device (MAD) responder phenotype are not well understood in patients with obstructive sleep apnea (OSA). Recent studies have reported the association between MAD treatment response and polysomnographic phenotypes using positional and sleep stage dependency, but with inconsistent findings. Thus, the study aims to investigate the relationship between the two phenotypes and MAD response.

Methods: This retrospective study recruited patients with OSA (apnea-hypopnea index [AHI] >10/h), who were 20 to 80 years old, treatment naïve, and received MAD treatment for more than three months from 2009 to 2017. AHIsupine/AHInon-supine ≥2 and <2 meant supine predominant (supine-p) and non-positional OSA,

respectively. REM-AHI/NREM-AHI ≥2, ≤0.5, and between 0.5 to 2 indicated REM-predominant (REM-p), NREM-predominant (NREM-p), and stage-independent (SI) OSA, respectively. Three criteria defined successful MAD treatment (i.e., criterion 1: residual AHI <5/h with >50% reduction; criterion 2: residual AHI 50% reduction; criterion 3: reduction >50%). The association between the two phenotypes and the three treatment criteria was identified using multivariable logistic regression.

Results: A total of 218 patients with a median age of 52.5 years, body mass index (BMI) of 25.4 kg/m2, and AHI of 28.2/h were recruited. Supine-p OSA had lower waist circumferences than non-positional OSA. The REM-p group had lower AHI and more female than the NREM-p and SI group. Supine-p OSA had better response than non-positional OSA (criterion 1: 43.2% vs 34.1%; criterion 2: 63.6% vs 34.1%; criterion 3: 77.3% vs 51.2%). NREM-p OSA had lower response across all three criteria (REM-p vs NREM-p vs SI: criterion 1: 57.6% vs 0% vs 42.0%; criterion 2: 75.8% vs 16.7% vs 56.5%; criterion 3: 75.8% vs 33.3% vs 77.1%). The odds of MAD response for supine-p OSA was 3.78 (95% CI = 1.44–9.93) to 3.98 (95% CI = 1.58–9.99)-fold than non-positional OSA while the odds for NREM-p OSA were 0.06 (95% CI = 0.01–0.58) to 0.15 (95% CI = 0.03–0.67)-fold than SI OSA after adjusting demographics and clinical features affecting MAD response.

Conclusion: Positional and sleep stage dependency were associated with MAD response and could be indicators for personal-tailored OSA treatment.

Support (if any): The Ministry of Science and Technology, Taiwan (MOST 109-2314-B-002-252)

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CELLULAR ENERGY MONITORING FOR DIAGNOSIS AND MANAGEMENT OF THERAPY FOR SLEEP DISORDERED BREATHING

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Introduction: Polysomnogram (PSG) monitoring, including pulse oximetry, is the current diagnostic standard in sleep medicine. However, potentially confounding aspects of PSG testing include: test site other than the subject's normal bed, distracting sensors and wires, subjective interpretation of complex recorded signals, and limited sensitivity to relevant phenomena. There is currently an unmet need for a sleep test that is more clinically effective than PSG, and that can be administered in the subject's normal sleeping environment. Additionally, confirmation that home therapy has been optimized cannot be achieved by PSG titration.

Methods: A recent proof of concept (POC) study of the armband-wearable Reveal Cellular Energy Monitor (CE monitor) directly compared its data product, Cellular Energy Index (CEi), with PSG data. Scoring methods were adapted from AASM guidance for interpretation of PSG data. At-home recording with the CE monitor was also performed prior to and following PSG studies. At-home incremental adjustment of APAP settings and mask selection was documented with CE monitoring and compared with the information recorded by the home APAP machine.

Results: The comparison of the POC data consistently found the CE monitor to be more sensitive and responsive to hypoxic stress than the PSG pulse oximeter during primary snoring. Obstructive and central apnea events were detected by both, but the CE monitor provided finer resolution of the breath-by-breath effort of breathing compared with PSG RIP and nasal sensors. At-home CE monitor optimization of therapy was documented to often differ from the settings and mask selection determined by PSG titration, and resulted in 'normal' sleep breathing data.

Conclusion: All diagnostically-relevant physiologic responses detected by PSG were also detected by the CE monitor. Evidence of cellular hypoxia in the skin, by CE monitor, was consistently recorded during prolonged periods of 'primary snoring;' i.e., SpO2 is less sensitive to hypoxic stress during sleep than CEi. Breath-by-breath effort is detected by the CE monitor.

Support (if any): The POC study costs at UCSF were paid by Reveal Biosensors, Inc.

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CHANGE OF SLEEP DISORDERED BREATHING SEVERITY IN OBESE PATIENTS RECEIVING LAPAROSCOPIC SLEEVE GASTRECTOMY

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Introduction: Bariatric surgery via laparoscopic sleeve gastrectomy (LSG) was proved to alleviate significantly in apnea hypopnea index (AHI) in obesity patients. We aimed to investigate LSG effects on AHI in different sleep stage (REM vs NREM) and in position (supine vs non-supine) and on CO2 reduction and to identify the factors associated of AHI reduction.

Methods: From April 2016 to December 2020, 22 obese patients who underwent PSG before and after bariatric surgery at National Taiwan university Hospital were retrospectively studied. The simultaneously nocturnal percutaneous transcutaneous CO2 (PtcCO2) monitoring was applied. Demographic, anthropometric characteristics, Epworth sleepiness scale (ESS), Pittsburgh Sleep Quality Index (PSQI), PSG parameters were reviewed. Responsive to treatment was defined as AHI reduction ≥50% and residual AHI< 10/hour.

Results: Postoperative PSG was performed in 22 patients [13 men and 9 women, median age 38 years (interquartile range, 32.8–46.5), median body mass index (BMI) 44.5 kg/m2 (39–52.5)] and median follow up days of 535 days (440–687) after LSG. The median post-op BMI was 32.4 kg/m2 (28.3–37.1). The AHI decreased from 51.9/h (27–85.9) to 10.7/h (2–16.3) (p<0.01). The AHINREM decreased from 49.9/h (31.8–91.5) to 5.8/h (1.1–17.3) while the AHIREM decreased from 63.7/h (52.5–83.2) to 19.6/h (4.4–49.7) /h. The AHIsupine decreased from 64.1/h (40.1–88.8) to 11.9/h (2.3–18.7) while the AHInon-supine decreased from 27.5 /h (17.6–78.3) to 1 /h (0–2). The average PtcCO2 decreased from 51.6 mmHg (39.3–54.7) to 46 mmHg (36.6–49.3) while %PtcCO2-total sleep time>50mmHg decreased

from 84.5% (0.1–99.1) to 0% (0–44.6). Logistic regression showed baseline higher AHI was independently associated with less treatment responsive [odds ratio, 0.909 (0.84–0.985)].
Conclusion: The AHI and PtcCO2 marked decreased via LSG where the residual AHI was lower in NREM than REM sleep; and in non-supine than supine. Baseline AHI is inversely associated with the residual AHI
Support (if any): Ministry of Science and Technology (MOST 109-2314-B-002-252)

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PATIENT FACTORS AND PREFERENCES IN DECISION FOR SLEEP SURGERY: A QUALITATIVE ANALYSIS

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Introduction: Patients with obstructive sleep apnea (OSA) are offered many treatment options spanning the spectrum of lifestyle modification, device therapy, and surgery. Sleep surgery, while often effective, results in moderate morbidity and has variable effectiveness on OSA improvement. Little is known about what patients consider when choosing treatment. We aim to identify factors that influenced the decision for sleep surgery among adults with OSA.
Methods: We conducted semi-structured virtual interviews with patients (≥18 years) with OSA (apnea-hypopnea index ≥5 events per hour of sleep) who underwent sleep surgery at a tertiary academic center, querying patients about factors in their decision for OSA treatment. Interviews were audio-recorded, transcribed, and analyzed for thematic content. We anticipate enrolling 10–18 total participants based on previously reported sample size in specialty groups for thematic saturation in specialty groups (ie, when no new concepts or factors emerge from interviews). Here we report pilot qualitative analysis results.
Results: Of nine eligible patients, eight enrolled (mean +/- standard deviation age 45.8 +/- 13.4 years, 2 female/6 males). Four patients underwent nasal surgery only, two patients underwent staged procedures, one underwent pharyngeal surgery only, and the last underwent nasal surgery with tori removal. Patients reported decision making duration of days to years for scheduling surgery. Reasons for pursuing sleep surgery included fatigue, quality of life, work performance, and safety. Overarching thematic domains related to decision for surgery were (1) major concerns, (2) external factors influencing decision, and (3) retrospective satisfaction/regret with decision. Major concerns involved factors beyond surgeon's control, such as anesthesia and postoperative pain management, not surgery itself. Family and friends were reported to be highly influential in the process, both in favor and against surgery. Social media features and celebrity patients with OSA heightened awareness of sleep surgery and set preconceived expectations. Patients were mostly satisfied with outcomes, despite unanticipated acute recovery challenges.
Conclusion: This pilot qualitative analysis identifies factors influencing patients' OSA treatment decisions. Understanding patients' major concerns and sources of information may help to guide physician counseling, set realistic expectations, offer peri-operative support, and better engage parents in shared decision-making for sleep surgery.
Support (if any): None.

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COST-EFFECTIVENESS OF REQUALIFYING FOR POSITIVE AIRWAY PRESSURE TREATMENT AFTER INITIAL NONADHERENCE

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Introduction: Obstructive sleep apnea (OSA) is effectively treated with continuous positive airway pressure (CPAP). However, many people are not able to become adherent in the initial 90-day trial window for this therapy. Medicare requires a polysomnography and repeat trial documenting adherence before continuing payment for these services. Oral appliance therapy (OAT) is also an OSA first-line therapy but is less effective than CPAP.
Methods: We created a decision tree to model 4 strategies over a 5-year time horizon: (1) current policy, (2) direct referral for CPAP equipment, (3) OAT followed by CPAP under current policy, and (4) OAT followed by direct CPAP referral in a the Medicare population with mild-moderate OSA and nonadherence to a first attempt at CPAP therapy. Medicare fee schedules in 2020 defined costs. Incremental cost-effectiveness (ICER) was used to identify the supreme strategy
Results: The current policy was the most expensive. Both the current policy and direct DME referral were dominated by starting with OAT. OAT followed by titration was the most cost-effective strategy with an ICER of $42,586.47. The ICER was sensitive to adherence in the direct CPAP strategy and probability of getting CPAP equipment (vs. lost to follow-up).
Conclusion: Starting with OAT therapy in those that were CPAP nonadherent on first attempt is cost-effective. Despite decreased effectiveness, the increase adherence to OAT make it an attractive option for retrial of OSA therapy. If OAT therapy fails, the current policy is more cost-effective than direct CPAP referral.
Support (if any): This study was supported Career Development Award IK2CX001882 from the United States (U.S.) Department of Veterans Affairs Clinical Sciences Research and Development Service. The contents of this work do not represent the views of the Department of Veterans Affairs or the United States government.

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OBESITY DOES NOT MODIFY THE EFFECT OF 4 MONTHS OF CPAP ON LEPTIN OR ADIPONECTIN

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Introduction: Leptin and adiponectin are cytokines produced by adipocytes. Leptin is involved in the pathogenesis of obesity and adiponectin is cardioprotective. Previous studies in adults with obstructive sleep apnea (OSA) assessing the effect of continuous positive airway pressure (CPAP) on these cytokines are conflicting, and whether obesity modifies the effect remains unknown. We examined the baseline and follow up levels of changes in plasma leptin and adiponectin following 4 months of CPAP treatment among obese (BMI>30) and non-obese (BMI≤30) participants.
Methods: We evaluated 221 adults (84.6% males) in the Penn Icelandic Sleep Apnea (PISA) Study, with mean (±SD) body mass index (BMI) 31.7±4.9 kg/m2 and apnea-hypopnea index (AHI) 35.7±15.6 events/hour. Associations between changes in natural log of the biomarkers in obese and non-obese participants were evaluated, controlling for a

priori baseline covariates of age, baseline BMI, race, sex, site, and current smoking status.
Results: The mean proportional change (from baseline to follow-up) in log-transformed adiponectin and leptin in CPAP adherent participants was not significantly different between BMI groups. The baseline to follow up change in leptin post-CPAP was 1.01 (95% CI 0.95–1.08) in obese participants and 1.05 (95% CI 0.96–1.14) in non-obese participants. For adiponectin, the change post-CPAP was 1.04 (95% CI 0.95–1.15) in obese participants and 1.08 (95% CI 0.96–1.22) in non-obese participants.
Conclusion: CPAP treatment did not have an impact on leptin or adiponectin levels. We also find no evidence for obesity modifying the effect of four months of CPAP on leptin or adiponectin.
Support (if any): 1P01-1HL094307

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OBESITY MODIFIES THE EFFECT OF 4 MONTHS OF CPAP ON GLUCOSE LEVELS IN ADULTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Continuous positive airway pressure (CPAP) therapy may improve insulin sensitivity and glucose tolerance seen in individuals with obstructive sleep apnea (OSA), however there is a lack of studies on whether obesity modifies the effect. We examined the baseline and follow-up levels of insulin and glucose following 4 months of CPAP treatment among participants with body mass index (BMI) <30, 30≤ BMI<35, and BMI≥35 kg/m2.
Methods: We identified 221 adults (84% males) with newly diagnosed OSA in the Penn Icelandic Sleep Apnea (PISA) Study, with a mean (±SD) BMI 31.7 +- 4.2 kg/m2 and apnea-hypopnea index (AHI) of 35.7+-15.6 events/hour. Associations between changes in natural log of the biomarkers within BMI groups were explored, controlling for a priori baseline covariates of age, baseline BMI, race, sex, site, and current smoking status.
Results: The mean proportional change (from baseline to follow-up) in log-transformed glucose in CPAP adherent participants was significantly larger in the BMI ≥35 and 30≤ BMI<35 groups compared to BMI <30. Within the BMI ≥35 group, the baseline to follow up increase in glucose post-CPAP was 1.08 (95% CI 1.01–1.15), while there were no significant changes in the other 2 BMI groups. A mediation analysis was performed with models including BMI change, and glucose was found to be significantly different between groups. There was no statistically significant association for insulin.
Conclusion: Our findings show that obesity modifies the effect of four months of CPAP on glucose levels.
Support (if any): 1P01-1HL094307

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ESOMEPRAZOLE USE IN UPPER AIRWAY STIMULATION PATIENTS ASSOCIATED WITH LOWER FUNCTIONAL THRESHOLD

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Introduction: Proton pump inhibitors (PPIs) are widely used for gastroesophageal reflux disease (GERD) despite possible side effects including increased susceptibility to infections, secondary hypergastrinemia, and incomplete absorption of micronutrients. Upper airway stimulation (UAS) surgery involves delivering an electrical impulse to the distal hypoglossal nerve for the management of obstructive sleep apnea.. The functional threshold (FT) is the minimum stimulation required to achieve bulk tongue motion. The minimum therapeutic amplitude (MTA) is the lowest voltage required to achieve clinical benefit during titration at postoperative attended overnight polysomnography. We sought to analyze the effect of perioperative PPI use upon patients who had undergone upper airway stimulation (UAS) surgery. We hypothesized that the ion transport-related effects of PPIs would impact the amplitude necessary for tongue protrusion (FT) and clinical benefit (MTA).
Methods: A retrospective chart review was conducted at a single tertiary care facility. Baseline demographic data, medication history, and comorbidities were collected from December 2014 through August 2019 on patients undergoing UAS surgery. Patients that were taking a PPI at the time of surgery and postoperatively were included.
Results: 167 patients that underwent UAS surgery between 2014 – 2019 were studied. 74 patients were found to be taking a PPI perioperatively. Specifically, 38 patients were found to be on omeprazole, compared to 17 on pantoprazole, 13 on esomeprazole, 4 on lansoprazole, and 2 on rabeprazole. Overall, esomeprazole was a statistically significant predictor (p=0.0359) of a lower functional threshold amplitude: 1.58 mV in controls as compared to 2.09 mV for omeprazole, 2.12 mV for pantoprazole, 2.14 mV for lansoprazole, and 2.7 mV for rabeprazole. Use of PPI, while associated with lower FT voltage, was not a predictor of statistically significant changes in initial UAS minimum therapeutic amplitude settings.
Conclusion: The functional threshold amplitude for patients taking esomeprazole was significantly different compared to patients not on a PPI. However, the use of PPI overall was not a statistically significant predictor of initial difference in UAS mean therapeutic amplitude settings. Future studies examining tolerance of therapy and voltage changes over time in patients on proton-pump inhibitors are needed.
Support (if any):

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THE IMPACT OF PAP THERAPY ON HEMATOCRIT IN OSA AND POLYCYTHEMIA: A PILOT STUDY

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Introduction: Untreated polycythemia leads to complications including thrombosis. Obstructive sleep apnea (OSA) is commonly associated with secondary erythrocytosis, which testosterone therapy can perpetuate. Effects of positive airway pressure (PAP) on elevated hematocrit (HCT) is unknown. We hypothesize PAP adherence can reduce HCT in men with OSA and polycythemia.
Methods: Retrospective chart review of male outpatients with newly diagnosed OSA and HCT≥45% at or 3 months before polysomnography (PSG) was conducted. Intervention group consisted of patients initiating PAP for OSA. HCT within 6 months of PAP initiation and PSG were recorded for intervention and control groups, respectively. Primary endpoint was time-to-HCT reduction of HCT<50% plus 3% decrease. Cox proportional-hazards analysis was used to assess time-to-HCT response. Demographics, smoking history, testosterone administration, STOP-Bang score, AHI, and PAP compliance data were obtained. Patients excluded if PAP not indicated, or if PSG, PAP compliance, or repeat HCT were unavailable.

Results: 41 men with OSA had HCT≥45%, of which 16 had HCT≥50%. Median age was 60 years and median BMI was 32 kg/m2. 28 started PAP. 21 met definition for PAP compliance within 6 months. Median AHI of intervention and control groups were 23 and 19 events/hr, respectively. Mean baseline HCT of both groups were 49 and 50, respectively. No significant difference in age, BMI, smoking history, testosterone therapy, and baseline HCT between both groups noted. 39% of intervention group exhibited HCT response at 1 or more longitudinal assessments, versus 38% of control. Intervention group had higher mean STOP-Bang than control (mean 5.9 vs. 4.6, p=0.01) and trended towards higher mean baseline AHI (27.4 vs. 19.0, p= 0.06). Time-to-event analysis controlling for STOP-Bang and AHI demonstrated PAP was not associated with time-to-HCT response (HR = 1.3, 95% CI = 0.4–4.4). In moderate-severe OSA patients, 40% of intervention group had HCT response compared to 14% of control, though difference was not significant (HR = 2.5, 95% CI = 0.3–20.0).
Conclusion: Moderate-severe OSA patients trended towards reduction in HCT with PAP, although not statistically significant. Testosterone administration did not affect HCT response to PAP in this cohort. Larger studies are required to determine HCT response to PAP in these patients.
Support (if any):

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THE EFFECT OF CARDIOVERSION THERAPY FOR ATRIAL FIBRILLATION ON AHI IN OBSTRUCTIVE SLEEP APNEA PATIENTS.

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Introduction: Sleep apnea (SA) is known to be associated with development of atrial fibrillation (AF), and therapy ameliorates this risk. Case reports and small series raise the possibility of a bidirectional effect of AF on SA burden. We hypothesize that SA control, demonstrated either by residual apnea-hypopnea index (AHI) or pressure during positive airway pressure (PAP) therapy, improves after successful cardioversion.
Methods: The cohort included VA patients with SA on PAP therapy who underwent successful outpatient direct-current AF cardioversion. Only patients with good adherence in the peri-procedural period, defined as use most days in the week before and after procedure, were included in the study (n=17). We compared AHI prior to and after cardioversion using the sign test since values were not normally distributed. Since most participants were on auto-titrating PAP, the sign test was also used to compare mean pressure difference in the 7 days before and after the procedure.
Results: There was no statistical difference when comparing AHI before and after AF cardioversion therapy (AHI change = -0.45, 95% CI = [-0.94, 0.17]) There was also no difference between mean pressure used for PAP therapy before and after therapy (pressure change = 0.05, 95% CI = [-0.1, 0.33]).
Conclusion: This small study did not find an association between successful AF cardioversion and PAP residual AHI or pressure (for auto-titrating machines). A larger cohort may have improved power to detect subtle effects of AF therapy on SA burden.
Support (if any): This study was supported by the Career Development Award IK2CX001882 from the United States (U.S.) Department of Veterans Affairs Clinical Sciences Research and Development Service.

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THE EFFECT OF UPPER AIRWAY STIMULATION THERAPY ON BLOOD PRESSURE

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Introduction: Upper airway stimulation (UAS) therapy is a novel technique in the treatment of Obstructive Sleep Apnea (OSA). UAS therapy is indicated for patients with moderate to severe OSA who fail therapy with Continuous Positive Airway Pressure (CPAP) and/or the use of a dental appliance. Although research suggests that CPAP can modestly improve patients' Blood Pressure (BP), little is known about the effect of UAS on BP.
Methods: Via a retrospective cross-sectional cohort study, we identified all patients undergoing UAS surgery at Brook Army Medical Center from July 2015 through July 2020. We captured pre-operative and post-operative data from a structured electronic medical record review, including Polysomnographic data and BP measurements at designated time points. We measured UAS therapy compliance in hours of usage per week. Statistical analysis includes paired T-tests to determine whether changes in BP and AHI were significant when comparing pre-operative and postoperative values.
Results: We report data for 12 patients treated with Upper Airway Stimulation therapy in our cohort. The mean pre-operative Systolic Blood Pressure (SBP) is 128.3±7 mmHg, the mean post-operative SBP is 122.8±10 mmHg with a mean difference of -5.4mmHg (standard error for difference 2.9mmHg). The mean pre-operative Diastolic Blood Pressure (DBP) is 80.0±6 mmHg, the mean post-op DBP is 76.4±8 mmHg, with a mean difference of -3.6mmHg (standard error for difference 1.9 mmHg). Neither of these are statistically significant, with P values of 0.09 and 0.08 respectively. The mean pre-operative Mean Arterial Pressure (MAP) is 96.1±6 mmHg, the mean post-op MAP is 91.9± 8 mmHg, with a mean difference of -4.2 mmHg (standard error for difference 1.7 mmHg). This represents a statistically significant difference with a P value of 0.03. Seven patients carried a pre-operative diagnosis of Hypertension whereas five did not. There is not a statistical difference in BP changes between these subgroups.
Conclusion: Upper Airway Stimulation surgery appears to decrease SBP, DBP, and MAP measurements with a similar magnitude as Positive Airway Pressure Therapy. In our cohort, only MAP changes appear to reach statistically significance. Further studies are warranted to elucidate the clinical significance of UAS on physiologic parameters such as blood pressure.
Support (if any):

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ALIANZA BARBED PHARYNGOPLASTY IN MODERATE TO SEVERE OSAS PATIENTS

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Introduction: Alianza barbed pharyngoplasty is a recent non-resective surgical tecnique, indicated for patients with obstructive sleep apnea syndrome (OSAS) with circular retropalatal obstruction pattern. It has the aim of stabilizing and reducing the collapsibility of the palato-pharyingeal area during sleep. It uses barbed absorbable sutures that allow to suspend palato-pharyngeal structures to anatomical non-collapsable landmarks (posterior nasal spine, pterigoideal hamulus, pterigomandibular raphe). The aim of this study is to evaluate efficacy and safety of Alianza barbed pharyngoplasty in moderate to severe OSAS.

Methods: Thirty-six consecutive patients with moderate to severe OSAS underwent Alianza barbed pharyngoplasty. Preoperatively all patients presented with palatal hypertrophy, concentric collapse and retropalatal flatter during drug induced sleep endoscopy (DISE) and did not tolerate CPAP and/or MAD therapies. All patients underwent clinical examination, polysomnography, and subjective evaluation of snoring with visual analogue scale (VAS) and Epworth Sleepiness Scale (ESS) both pre-operatively (T0) and at 6 months postoperatively (T1).
Results: There was a significant reduction of AHI at T1, from 32.49 ± 14.55 to 12.1 ± 12.16 ($p< 0.05$) of AHI. Mean AHI gain was of 20.39 ± 11.58, in particular 13.34 ± 5.48 in moderate OSAS patients and 30.18 ± 9.34 in severe OSAS patients. There was also a significant ODI reduction, from 27.57 ± 15.68 to 12.97 ± 13.25 ($p< 0.05$). There was a significant reduction of ESS, from 8.75 ± 4.51 to 4.05 ± 2.39 ($p< 0.05$) and a significant reduction of snoring VAS from 7.85 ± 1.23 to 3.2 ± 1.7 ($p< 0.05$).
Conclusion: Alianza barbed pharyngoplasty led to significant improvement both in objective parameters measured with polysomnography (AHI and ODI), and in subjective parameters (ESS and snoring VAS) in moderate to severe OSAS patients.
Support (if any):

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HYPOGLOSSAL NERVE STIMULATION: EFFECTIVENESS OF THERAPY FOR TREATMENT OF POSITIONAL OBSTRUCTIVE SLEEP APNEA

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Introduction: Hypoglossal nerve stimulation (HGNS) therapy is highly effective treatment for patients with moderate-severe obstructive sleep apnea (OSA). Positional OSA is considered when the apnea-hypopnea index (AHI) is at least twice as high in supine position compared with non-supine position. There are few studies in the literature investigating response to HGNS in patients with positional OSA.
Methods: Pre- and post-implant polysomnography (PSG) data was retrospectively reviewed in 46 patients who underwent HGNS at a large tertiary care center from November 2017 to March 2020. Supine and non-supine AHI were used to diagnose positional OSA on pre- and post-implant PSG. Pre-implant AHI was recorded from both in-lab PSG as well as home sleep tests, while post-implant AHI was based on in-lab hypoglossal nerve stimulator titration performed three months after device activation. Overall AHI pre- and post-implantation and absolute AHI reduction (pre-implant AHI – post-implant AHI) were evaluated. Basic demographic information including age, sex and BMI were also recorded.
Results: 25/46 patients (54%) were diagnosed with positional OSA on pre-implant PSG. Patients with positional OSA had lower pre-implant overall AHI than patients without positional OSA (AHI 29.6 and 38.9, respectively, $p<0.05$) and lower absolute AHI reduction than patients without positional OSA (18.2 and 26.7, respectively, $p<0.05$). There were no statistically significant differences in BMI and post-implant overall AHI between these groups. 19/25 patients (76%) with pre-implant positional OSA had persistent positional OSA on post-implant PSG.
Conclusion: Patients with positional OSA prior to HGNS had lower pre-implant overall AHI and absolute AHI reduction than patients without positional OSA. However, post-implant overall AHI was comparable, suggesting similar benefit in HGNS therapy regardless of positional OSA diagnosis. HGNS does not appear to resolve positional OSA, given that 76% of patients with positional OSA pre-implantation had persistent positional OSA post-implantation. Positional OSA after HGNS should be recognized in patients with persistent symptoms or inability to tolerate higher device amplitudes, and treatment with combination therapy with positional device can be considered.
Support (if any):

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REDEFINING POSITIVE AIRWAY PRESSURE ADHERENCE PHENOTYPES UTILIZING DEEP NEURAL NETWORKS AND UNSUPERVISED CLUSTERING

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Introduction: Improving positive airway pressure (PAP) adherence is crucial to obstructive sleep apnea (OSA) treatment success. We have previously shown the potential of utilizing Deep Neural Network (DNN) models to accurately predict future PAP usage, based on predefined compliance phenotypes, to enable early patient outreach and interventions. These phenotypes were limited, based solely on usage patterns. We propose an unsupervised learning methodology for redefining these adherence phenotypes in order to assist with the creation of more precise and personalized patient categorization.
Methods: We trained a DNN model to predict PAP compliance based on daily usage patterns, where compliance was defined as the requirement for 4 hours of PAP usage a night on over 70% of the recorded nights. The DNN model was trained on N=14,000 patients with 455 days of daily PAP usage data. The latent dimension of the trained DNN model was used as a feature vector containing rich usage pattern information content associated with overall PAP compliance. Along with the 455 days of daily PAP usage data, our dataset included additional patient demographics such as age, sex, apnea-hypopnea index, and BMI. These parameters, along with the extracted usage patterns, were applied together as inputs to an unsupervised clustering algorithm. The clusters that emerged from the algorithm were then used as indicators for new PAP compliance phenotypes.
Results: Two main clusters emerged: highly compliant and highly non-compliant. Furthermore, in the transition between the two main clusters, a sparse cluster of struggling patients emerged. This method allows for the continuous monitoring of patients as they transition from one cluster to the other.
Conclusion: In this research, we have shown that by utilizing historical PAP usage patterns along with additional patient information we can identify PAP specific adherence phenotypes. Clinically, this allows focus of PAP adherence program resources to be targeted early on to patients susceptible to treatment non-adherence. Furthermore, the transition between the two main phenotypes can also indicate when personalized intervention is necessary to maximize treatment success and outcomes. Lastly, providers can transition patients in the highly non-compliant group more quickly to alternative therapies.
Support (if any):

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THE EFFECT OF INTERVENTION OF MEDICAL STAFF ON THE ADHERENCE OF CPAP AND HEART RATE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA.

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Introduction: Recent studies have indicated that obstructive sleep apnea syndrome (OSAS) is associated with hypertension. OSA is a common cause of sympathetic nervous activity. Increase of sympathetic nervous activity causes hypertension. Continuous positive airway pressure (CPAP) is the most useful treatment for OSAS. Good CPAP adherence treatment improve the risk of hypertension. This study examined the effect of intervention of medical staff on the adherence of CPAP, heart rate and sleep stages in patients with OSA.
Methods: All patients diagnosed with OSA and undergoing subsequent CPAP were clinically followed for 12 months to examine CPAP adherence, as well as longitudinal changes in blood pressure, average heartrate of 24 hours and sleep stages. They were divided into 2 groups, Group A: patients who had individual consulted in person by sleep physician and technicians before start using CPAP and Group B: patents who did not have individual consulted. Patients in both groups were consulted by sleep physician and technicians after start CPAP with utilizing tele-monitoring. If the adherence were poor, the patients were recommended to stop CPAP. We provided 3D accelerometer and an optical pulse photoplethysmography to all the patients and analyzed the data of heart rate and sleep stages.
Results: A total of 30 OSA patients underwent CPAP, were enrolled in the study and assessed for changes in mean heart rate and body weight during the study period. We found a significant reduction in mean heart rate in both group A and B compared with baseline ($p<-0.05$). The patients aged under 50 years old and whose AHI<20 times/hour have higher ratio of dropout CPAP therapy. There was no significant difference between Group A and Group B on the persistency rate of CPAP therapy. Also, no significant association was found between group A and B on the adherence of CPAP.
Conclusion: We showed the importance of the effect of intervention of medical staff on the adherence of CPAP and heart rate in patients with OSA the consultation after starting CPAP for a while with utilizing tele-monitoring data would be more effective compared with that in person before start using CPAP.
Support (if any):

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LONG TERM EFFECTS OF CONTINUOUS POSITIVE AIRWAY PRESSURE ON THE WEIGHT OF OBSTRUCTIVE SLEEP APNEA PATIENTS IN THE SOUTHEAST USA.

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Introduction: Obesity has been linked to exacerbating Obstructive Sleep Apnea in patients. Paradoxically however, effective CPAP therapy has been noted to lead to weight increases even while improving hypersomnia and daytime neurocognitive functioning. Prior studies have demonstrated inconsistent results regarding weight changes while on CPAP therapy. Our study aims to clarify these inconsistencies and provide specific recommendations for CPAP compliant patients to prevent weight gain.
Methods: 393 OSA patients were seen for multiple follow ups since initiation of CPAP therapy at a single center sleep clinic. Every visit their weight would be updated along with CPAP compliance. Data was assessed on 1 month, 6 month, and 12 month intervals. Exclusion criteria include diuretic use, diet/exercise additions, and discontinuation of CPAP therapy before the full observation window.
Results: Patients with long term use of their CPAP devices had an average increase of 2.68±11.29 lbs after a year. 233 participants gained weight (an average of 9.8±7.3 lbs) while 141 participants lost weight (an average of -8.5±7.2 lbs) with 19 participants showing no weight change. This weight change could be observed starting as early as one month after CPAP initiation.
Conclusion: CPAP therapy is most likely linked to a lasting increase in weight. Recommendations and patient education for OSA patients should be modified to include an exercise component (10,000 steps/day) and/or caloric restriction (2200 low carb diet) to offset this weight increase. Further study is needed to assess the impact such recommendations could have in long term OSA care beyond the southeast USA.
Support (if any): Pulmonary Allergy & Sleep Center of Augusta

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EVALUATING THE IMPACT OF SLEEP DISORDERED BREATHING ON ADVERSE CARDIOVASCULAR OUTCOMES AFTER BARIATRIC SURGERY

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Introduction: Sleep disordered breathing (SDB), including obstructive sleep apnea (OSA) and obesity-associated sleep hypoventilation (OASH), has well-characterized adverse effects on the cardiovascular system and increases morbidity and mortality. Long-term impact on cardiovascular outcomes post-bariatric surgery, however, remains unclear. We hypothesize that patients with SDB have increased frequency of major adverse cardiovascular events (MACE) post-bariatric surgery than those without.
Methods: Patients undergoing polysomnography (PSG) prior to bariatric surgery at The Cleveland Clinic from 2011–2018 were retrospectively examined and followed up from date of last surgery to 2019, including the perioperative period. Primary predictors include moderate-severe OSA, i.e. apnea hypopnea index(AHI)>15, and OASH, i.e. body mass index (BMI)≥30kg/m2 and either end-tidal CO2≥45mmHg or serum bicarbonate≥27mEq/L. MACE (coronary artery events, cerebrovascular events, heart failure or atrial fibrillation)-free probability was compared using hazard ratios estimated from Cox proportional hazards models on four groups: OASH with moderate-severe OSA (N=492), OASH-only (N=442), moderate-severe OSA-only (N=203), and a reference group without OASH or moderate-severe OSA (N=243). Multivariable Cox proportional hazards models adjusting for age, sex, BMI were fit on MACE survival. Analysis was performed based on an overall significance level of 0.05, using SAS software (version 9.4, Cary, NC).
Results: The sample comprised 1380 patients: age: 43.5±12 years, BMI: 49±9 kg/m2, 17.7% male, 63.7% White. Risk of MACE across the groups bordered significance (p=0.051). Compared to the reference group, the OASH with moderate-severe OSA group had higher risk of MACE (HR2.53, 95%CI:1.07–6.00,p=0.035). Patients with moderate-severe OSA had higher risk of MACE than those with AHI<15 (HR1.94, 95%CI:1.20–3.13,p=0.007). Patients with severe OSA had higher risk of MACE than those AHI<30 (HR2.01, 95%CI:1.28–3.14,p=0.002). For every 5-unit AHI increase, risk of MACE increased by 6% (HR1.056, 95%CI:1.029–1.084,p<0.001) with slight reduction in point estimates in adjusted models.

Conclusion: Preliminary data from this largest-to-date sample of systematically phenotyped patients with SDB undergoing bariatric surgery show significant differences in risk of MACE and MACE-free survival mitigated after consideration of obesity. Further investigation to elucidate effect modification by obesity and metabolic factors is needed.
Support (if any): Cleveland Clinic Transformative Resource Neuroscience Award

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TRANSVENOUS PHRENIC NERVE STIMULATION FOR CENTRAL SLEEP APNEA: A SYSTEMATIC REVIEW

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Introduction: RespiCardia™ remedē® System, a transvenous phrenic nerve stimulator, is indicated to treat central sleep apnea (CSA) in certain patients. CSA involves disruption of the normal breathing pattern during sleep; CSA is associated with decreased patient quality of life and worsens cardiovascular outcomes. Existing therapies for CSA are often complicated by poor patient adherence to therapy and occasional adverse effects. The remedē® System uses electrical stimulation of the phrenic nerve to cause diaphragmatic contraction and attempts to restore normal breathing during sleep.
Methods: Systematic review was conducted according to the Preferred Reporting of Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Databases were queried by two independent reviewers for English-language studies published between 2000 and 2020. The initial search screened for all occurrences of "remede" then was further refined to include studies evaluating use of the RespiCardia™ remedē® System as a treatment for CSA in multiple patients.
Results: Two hundred twenty-seven articles were identified from initial search results. Fourteen articles were identified through screening of title and abstracts from initial results. Seven additional articles were identified through reference review. Full-text review of all the articles was then completed. All articles were published after 2010. Of the 21 articles, a total of 1621 patients underwent device implantation. We sought to summarize the available evidence regarding patient selection for implantation, immediate and delayed complications, adherence to therapy, and polysomnographic evidence of efficacy.
Conclusion: The remedē® System has been demonstrated to improve sleep and respiratory parameters including AHI, CAI, arousal index, REM sleep, and ODI with few complications. This device proves to be a safe and effective treatment for moderate to severe CSA in adult patients, especially those with HF. Future studies examining long-term outcomes and delayed complications are needed.
Support (if any):

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POSITIVE AIRWAY PRESSURE TRACKING SYSTEMS: OUTCOMES OF POLYSOMNOGRAPHIC TESTING PROMPTED BY THE RESIDUAL APNEA HYPONEA INDEX

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Introduction: To assess positive airway pressure (PAP) adherence and efficacy, tracking systems have been developed to monitor hours of CPAP use, mask leak, and residual apnea-hypopnea index (AHI) while patients are on treatment. No formal guidelines however have been developed on how to interpret and utilize this information. We looked at treatment outcomes after an in-laboratory sleep study reevaluation was made based on clinical symptoms and the residual AHI.
Methods: We performed a retrospective chart review of adult patients evaluated with an in-laboratory polysomnogram (PSG) based on a clinical concern for inadequately treated obstructive sleep apnea (OSA) and the residual AHI obtained from the PAP tracking system. We documented the outcomes of the repeat study and follow-up AHI after the new intervention (if recommended). We excluded patients non-adherent to PAP.
Results: Nine patients were identified between January 2015 and 2020 at the McGovern Medical School Outpatient Sleep Clinic. All nine patients were male with an average age of 69.2 years (range 44–84). The average AHI on the diagnostic study (CMS criteria) was 37.1 events/hour (range 17.4–67.1). The average residual AHI prompting reevaluation was 9 events/hour (median 15.9). All patients had a change in treatment based on recommendations made after their sleep study. The clinical suspicion for central events on the tracking system was confirmed on PSG on three patients who were subsequently switched to adaptive servo-ventilation. Two patients were found to have central events without a previous suspicion for central events. Four were prescribed a higher pressure or BPAP for suspected untreated OSA confirmed on the repeat PSG. All of the patients had a decreased residual AHI (average 6.3 events/hour) after treatment changes were made.
Conclusion: Reevaluation with a PSG after concerns of the residual AHI led to a change in diagnosis (complex sleep apnea) or the need for higher treatment pressures in our cohort. This lead to the optimization of therapy and a decrease in AHI on the tracking system post-intervention, hence justifying the repeat PSG. Exact guidelines however need to be set to standardize the recommendations with a potential cut-off residual AHI after which a repeat PSG is the standard.
Support (if any):

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OPTIMIZING TREATMENT OF THE INTRA-ORAL NEGATIVE AIR PRESSURE FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: The intra-oral negative air pressure device (iNAP) is designed to develop a negative pressure gradient in the oral cavity of the user. The pressure gradient provides a force to move the tongue and soft palate forward. Previous works show the treatment response rate of intra-oral pressure therapy varying between 25–79%. However, for those OSA patients with very high BMI or AHI, they may need higher pressure to achieve optimizing treatment outcome.
Methods: To provide an optimizing treatment of intra-oral pressure, 30 patients treated with iNAP successfully completed one baseline PSG and one treatment PSG with in-laboratory pressure adjustment. When conducting the iNAP titration PSG, the initial treatment pressure is 40mmHg. iNAP pressure should be increased by at least 10mmHg an interval no shorter than 15 min. In order to eliminate obstructive respiratory events, iNAP pressure should be increased when observe obstructive apnea or hypopnea or unambiguous snoring.
Results: A total of 30 patients presented their consent to participate in this study. The mean age of the patients was 51.2 ± 13.97 years, and their mean body mass index (BMI) was 25.87 ± 3.41 kg/m2. The mean baseline AHI was 39.59 ± 20.05 events/h, which decreased significantly to 8.17 ± 8.11 events/h. No significant change in sleep efficacy, and percentage of N1 stage was found in the treatment PSG. However, significant improvements in the percentage of N3 stage, Min SpO2, and arousal index were observed in the treatment PSG.

Conclusion: In this study, the clinical response rate, as defined by the Sher criteria, was 86% (26/30 patients), when the Tx PSG response was compared with the baseline values. Besides, the mean AHI under final titration pressure is 2.58. The results show that increasing intraoral pressure would help to further improve the sleep apnea.
Support (if any): This study was sponsored by Somnics, Inc.

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UTILIZATION OF THE STOP-BANG QUESTIONNAIRE FOR REFERRAL OF OBSTRUCTIVE SLEEP APNEA IN VARIOUS GEOGRAPHICAL REGIONS

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Introduction: Obstructive sleep apnea (OSA) is a highly prevalent global health concern and is associated with many adverse outcomes for patients. Our objective is to determine the utility of the STOP-Bang questionnaire in the sleep clinic setting to screen for and stratify the risk of OSA among populations from different geographical regions.
Methods: The following electronic databases were systematically searched from 2008 to March 2020: MEDLINE, Medline-in-process, Embase, EmCare Nursing, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, PsycINFO, Journals @ Ovid, Web of Science, Scopus, and CINAHL. Inclusion criteria were: 1) assessment of the STOP-Bang questionnaire to screen for OSA in adult subjects (age ≥18 years); 2) patients referred to sleep clinic; 3) lab-polysomnography or home sleep apnea testing results confirmed the OSA diagnosis; and 4) apnea-hypopnea index (AHI) or respiratory disturbance index (RDI) was used to diagnose and grade the severity of OSA. Clinical and demographic data were extracted from each article independently by two reviewers (B.P., L.C.). Pooled predictive parameters were calculated using 2x2 contingency tables. Random effects meta-analyses and meta-regression with sensitivity analyses were performed. The Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) guidelines were followed.
Results: Forty-seven studies (n=26,547) studies met the criteria for systematic review (mean age: 49±14 years, mean body mass index: 32±8 kg/m2, 65% male). Studies were organized into different geographic regional groups – North America, South America, Europe, Middle East, East Asia, and South/Southeast Asia. The prevalence of all OSA, moderate-to-severe OSA, and severe OSA was 80%, 58%, and 39%, respectively. The area under the receiver operating curve of a STOP-Bang score ≥3 to detect moderate-to-severe OSA is high (>0.80) in all regions, except in East Asia (0.52). A STOP-Bang score ≥ 3 has excellent sensitivity (>90%) and high discriminative power to exclude moderate-to-severe, and severe OSA with negative predictive values of 77% and 91%, respectively.
Conclusion: The meta-regression analysis demonstrates that the STOP-Bang questionnaire can be utilized as an effective OSA screening tool among different geographical populations to assist in prioritizing patients with suspected OSA for assessment in sleep clinic.
Support (if any):

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MATERNAL HABITUAL SNORING AND BLOOD PRESSURE TRAJECTORIES IN PREGNANCY

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Introduction: Habitual snoring has been associated with hypertensive disorders of pregnancy. However, exactly when blood pressure (BP) trajectories diverge between pregnant women with and without habitual snoring is unknown. Moreover, the potentially differential impact of chronic versus pregnancy-onset habitual snoring on maternal BP trajectories during pregnancy has not been examined.
Methods: In a cohort study of 1,305 pregnant women from a large Midwestern medical center, participants were asked about habitual snoring (≥3 nights/week) and whether their symptoms began prior to or during pregnancy. Demographic and BP data throughout pregnancy, systolic (SBP) and diastolic (DBP) were abstracted from medical charts. Linear mixed models were used to examine associations between habitual snoring-onset and pregnancy BP trajectories.
Results: Thirty percent of women reported snoring before pregnancy (chronic snoring) and an additional 23% reported pregnancy-onset snoring. Overall, women with pregnancy-onset snoring had higher mean SBP and DBP compared to those with chronic habitual snoring or controls (non-habitual snoring). In gestational week-specific comparisons with controls, SBP became significantly higher around 20 weeks' gestation among women with pregnancy-onset snoring and in the third trimester among women with chronic snoring. Pairwise mean differences in DBP were significant only among women with pregnancy-onset snoring relative to controls, after 15 weeks' gestation.
Conclusion: In a large cohort of pregnant women, those with pregnancy-onset or chronic habitual snoring had significantly elevated systolic BP in comparison to non-habitual snoring controls, in the second and third trimester, respectively. The findings of divergent BP trajectories suggest the two groups of women with habitual snoring in pregnancy should be considered separately when evaluating gestational 'windows' for increased BP monitoring and provide insight into pathophysiologic changes.
Support (if any): Dr. Dunietz was supported by an F32 National Research Service Award from the National Institute of Child Health and Development (NIH/NICHD F32 HD091938); Dr. O'Brien was supported by the following during the course of this study: the Gene and Tubie Gilmore Fund for Sleep Research, the University of Michigan Institute for Clinical and Health Research (MICHR) grants UL1RR024986 and UL1TR000433, MICHR seed pilot grant F021024, the National Heart, Lung, and Blood Institute (R21 HL089918 and K23 HL095739) and in part by R21 HL087819.

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IDENTIFYING GAPS IN EVALUATION, TREATMENT, AND TREATMENT ADHERENCE IN WOMEN VETERANS WITH SLEEP DISORDERED BREATHING RISK FACTORS

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Introduction: In our recent national survey study, 13% of women Veterans reported a diagnosis of Sleep Disordered Breathing (SDB), of whom 65% used positive airway pressure (PAP) treatment. We also found many women Veterans at high risk for SDB were undiagnosed (43%). The current study builds upon this survey research to identify rates of evaluation, diagnosis, treatment, and treatment adherence among women Veterans with risk factors for SDB.
Methods: We analyzed telephone screening data from an ongoing SDB treatment adherence intervention study for women Veterans in Los Angeles county. A total of 173 women Veterans, identified by retrospective chart review as having at least one risk factor for SDB (i.e. high blood pressure, diabetes, obesity, depression, or > 50 years old), completed the screener. Screening questions included 1) previous diagnostic testing for SDB, 2) SDB diagnosis 3) SDB treatment type, and 4) past week SDB treatment use. Descriptive statistics regarding evaluation and treatment of SDB are reported.
Results: In total, 31% of respondents endorsed having previously completed diagnostic testing, of whom, 54% reported an SDB diagnosis. Of those with diagnosed SDB, 82.8% were prescribed treatment (PAP [72.4%], oral appliance [6.9%], surgery [3.5%]), and 17.2% did not report being prescribed any SDB treatment. Of the 21 (72.4%) women Veterans diagnosed with SDB that were prescribed PAP, only 33% reported using treatment in the past week. Of the 2 women Veterans (6.9%) prescribed an oral appliance, 0% reported past week use.
Conclusion: Less than 1/3 of women Veterans with at least one risk factor for SDB had previously been evaluated for SDB; however, over 1/2 of women Veterans who were evaluated tested positive for SDB. Additionally, most women Veterans had not used PAP or oral appliance therapy in the past week. Greater clinical attention is needed to identify, evaluate, and diagnose SDB in women Veterans. Moreover, further research is needed to evaluate and inform interventions to address SDB treatment adherence barriers in women Veterans.
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SLEEP QUALITY IN PREGNANCY: AN ANALYSIS OF CARDIOPULMONARY COUPLING IN THE NUMOM2B COHORT

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Introduction: The impact of pregnancy on sleep quality and sleep-breathing is of interest due to concerns of an impact on maternal, intrauterine and neonatal health. The Sleep Disordered Breathing (SDB) sub-study of the Nulliparous Pregnancy Outcomes Study (NuMoM2b) provided a large cohort of single gestational women who underwent home sleep apnea testing (HSAT) to evaluate for SDB. To evaluate changes in sleep during pregnancy, we utilized publicly available data from http://www.sleepdata.org for cardiopulmonary coupling (CPC) analysis to evaluate SDB, as well as sleep duration and quality. No outcomes data is currently available.
Methods: Standardized Level 3 HSAT was performed after visit 1 (V1), (6–15 weeks' gestation) and visit 3 (V3), (22 -31 weeks' gestation) on 3702 women from the NuMoM2b cohort. CPC-analysis was performed using clinically validated algorithms based on CPC-method using ECG and oxygen saturation data (SpO2) as the input signals. SleepImage Apnea Hypopnea Index (sAHI) was calculated to evaluate for SDB (FDA; 182618). Additional calculations to determine sleep latency, sleep duration, wake after sleep onset, and sleep quality (SQI) were performed. The SQI-metric incorporates measures of sleep stability and instability and is then presented on a scale of 0 – 100 where a higher number is desirable.
Results: 3,261 & 2,511 participants had data at visits 1 & 3, respectively. A total of 3,012 and 2,332 individuals had ECG data of sufficient quality. The mean age of the analyzed cohort was 27 years old. SDB events were overall low, but significantly increased across visits, sAHI [(1.6 ± 2.5)/hour (V1) vs (2.9 ± 4.1) (V3)], $p < 0.001$. There was a statistically significant increase in sleep latency [7.4 ± 12.7 (V1) vs 18.7 ± 27.8 (V3)], $p < 0.001$ and reduction in total sleep time [401.2 ± 85.6 (V1) vs 348.5 ± 79.3 (V3)], $p < 0.001$. Most notably, there was a >10% reduction in the SQI, indicative of increased unstable, fragmented sleep as pregnancy progressed [72.1 ± 13.8 (V1), 60.5 ± 16.2 (V3)], $p < 0.001$.
Conclusion: Using objective measures based on CPC analysis from HSAT derived signals, sleep disordered breathing, sleep duration and sleep quality are all adversely impacted as gestation progresses.
Support (if any):

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EFFECTIVENESS OF TAILORED PEER-BASED SLEEP HEALTH EDUCATION AND SOCIAL SUPPORT IN INCREASING HOME-BASED OSA SCREENING AMONG BLACKS

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Introduction: Our Sleep Disparity Workgroup has investigated several approaches to reducing sleep health disparities. In the METSO trial, we observed phone-delivered sleep education addressing impediments to OSA care among blacks was successful in increasing OSA evaluation. We found in the TASHE trial web-based sleep education significantly increased OSA self-efficacy among blacks. In the present RCT, we examined the role of congruent peer sleep educators and social support (PEERS-ED) in navigating blacks seeking OSA care.
Methods: In the two study arms RCT, we ascertained PEERS-ED's effectiveness in increasing OSA screening among 317 blacks at OSA risk (intervention=159 and control=158); the average age was 47±12.9 years, 41% were male. OSA risk was assessed with the ARES questionnaire, administered in barbershops, and places of worship. Data also included assessment of beliefs and attitude (DBAS), apnea knowledge (AKT), apnea beliefs (ABS), readiness to change, anxiety, depression, and social support. Participants in the intervention arm received quality-controlled, culturally and linguistically tailored OSA education by trained PEERS during a 6-month period. The present analysis focused on the PEERS-ED effectiveness in increasing physician-recommended home-based OSA screening. Analysis also considered the role of psychosocial factors in adherence to OSA screening. Analyses were performed using the R-studio software.
Results: Results showed no significant differences in baseline demographic and clinical measures contrasting patients in the arms. The adherence rates for OSA screening between the intervention and control arms were 45.9% and 45.6%, respectively. The average DBAS and ABS scores were significantly greater among blacks who had home-based screening (DBAS: 6.0±1.8 vs. 4.9±2.2; p=0.024 and ABS: 77.0±7.1 vs 73.2±7.4; p=0.041). Other measures did not show significant differences between patients who had OSA screening versus those who did not. We observed those who screened were likely to experience greater level of social support (8.23±2.36 vs 7.31±2.35; p=0.063).

Conclusion: Our previous METSO trial demonstrated tailored OSA education is critical to increase adherence to recommended OSA care. While delivery of health information is generally associated with enhanced adherence to medical care, results of the present RCT favored an important role of peer-based social support leading to behavioral change towards receipt of OSA care.
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PHENOTYPING OF PATIENTS WITH MODERATE TO SEVERE OSA ON POLYSOMNOGRAPHY AFTER NEGATIVE HOME SLEEP APNEA TESTING

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Introduction: Polysomnography (PSG) is the gold standard for the diagnosis of obstructive sleep apnea (OSA). Given cost, insurance restrictions and in some cases limited access to sleep center testing, the use of home based sleep apnea testing is becoming increasingly more common. A proportion of patients with technically adequate HSAT who are negative end up having significant disease on PSG. The characteristics of patients who are found to have moderate to severe sleep apnea on polysomnogram (PSG) after a negative home sleep apnea test (HSAT) are not known. We aim to phenotype these patients.
Methods: We conducted a retrospective chart review from March 2018 to February 2020. A total of 953 adult patients (18 years old and older) underwent HSAT, 248 tests resulted negative (apnea-hypopnea index <5/h). Out of the negative HSAT, 17 patients had moderate to severe obstructive sleep apnea on PSG. Those were included for analysis. Data on patient characteristics such as age, body mass index (BMI), gender, STOP-BANG, ESS and comorbidities was gathered. Respiratory disturbance index, recording time, flow time, oximetry time on HSAT was recorded. PSG recording time, baseline AHI, supine AHI and non-supine AHI were also noted. Technically inadequate HSAT were excluded from analysis.
Results: The percentage of patients with negative HSAT who were found to have moderate to severe sleep apnea on PSG and were included for analysis was 6.85% (n17). Mean age was 41 years. Mean BMI was 33 kg/m2. Common comorbidities were hypertension (29%), asthma (17.6 %), depression (17.6%), anxiety (11.7%) and reflux (5.9%). Average ESS was 11.7 and STOP-BANG was 3.8. The mean recording time was 477 minutes, flow time 391 minutes and oximetry time was 426 minutes on HSAT. Average PSG recording time was 433 minutes. Average AHI was 24 with supine being 33.2/h and non-supine 17.9/h.
Conclusion: A proportion of patients with negative HSAT have moderate to severe OSA on follow-up polysomnogram. These patients were young, with lower-class obesity, more positional OSA, and no associated complex comorbidities. Re-evaluation of current diagnostic algorithms and further research is needed to phenotype this at-risk group, as first-line PSG may be more cost-effective and efficient.
Support (if any):

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AUTOMATIC DETECTION OF SELF-SIMILARITY AND PREDICTION OF CPAP FAILURE

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Introduction: Sleep disordered breathing is a significant risk factor for cardiometabolic and neurodegenerative diseases. Tolerance and efficacy of continuous positive airway pressure (CPAP), the primary form of therapy for sleep apnea, is often poor. High loop gain (HLG) is a driving mechanism of central sleep apnea or periodic breathing. The current study aimed to develop a computational approach to detect HLG based on self-similarity in respiratory oscillations during sleep solely using breathing patterns, measured via Respiratory Inductance Plethysmography (RIP). To quantify the potential utility of the developed similarity metric, the presented algorithm was used to predict acute CPAP failure.
Methods: We developed an algorithm for detecting apneas as periods with reduced breathing effort, manifested in the RIP signal as low signal amplitude. Our algorithm calculates self-similarity in breathing patterns between consecutive periods of apnea or hypopnea. Working under the assumption that high loop gain induces self-similar respiratory oscillations and increases the risk of failure during CPAP, the full night similarity, computed during diagnostic non-CPAP polysomnography (PSG), was used to predict failure of CPAP, which we defined as titration central apnea index (CAI)>10. Central apnea labels are obtained both from manual scoring by sleep technologists, and from an automated algorithm developed for this study. The Massachusetts General Hospital (MGH) sleep database was used, including 2466 PSG pairs of diagnostic and CPAP titration PSG recordings.
Results: Diagnostic CAI based on technologist labels predicted failure of CPAP with an AUC of 0.82 ±0.03. Based on automatically generated labels, the combination of full night similarity and automatically generated CAI resulted in an AUC of 0.85 ±0.02. A subanalysis was performed on a population with technologist labeled diagnostic CAI>5. Full night similarity predicted failure with an AUC of 0.57 ±0.07 for manual and 0.65 ±0.06 for automated labels.
Conclusion: This study showed that central apnea labels can be derived in an automated way. The proposed self-similarity feature, as a surrogate estimate of expressed respiratory high loop gain and computed from easily accessible effort signals, can detect periodic breathing regardless of admixed obstructive features such as flow-limitation, and can aid prediction of CPAP failure or success.
Support (if any):

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SLEEP-DISORDERED BREATHING IS MORE PREDICTIVE THAN OBESITY OF INCREASED LEFT VENTRICULAR MASS INDEX IN BARIATRIC SURGERY PATIENTS

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Introduction: Obesity and obstructive sleep apnea (OSA) are associated with left ventricular hypertrophy and increased cardiovascular risk. Alternatively, the "obesity paradox" describes an improved prognosis from heart failure in obesity, though potentially attributable to confounding/bias. We sought to determine the contributions of obesity and sleep-disordered breathing (SDB) to left ventricular function and morphology in bariatric surgery candidates.
Methods: Patients undergoing polysomnography prior to bariatric surgery from 2011–2018 had demographic (age, gender, race),

anthropometric (body mass index [BMI], neck circumference), comorbidities (atrial fibrillation, coronary artery disease, diabetes, hypertension, hyperlipidemia), echocardiographic and sleep-disordered breathing (apnea-hypopnea index [AHI], peak end-tidal CO2 [etCO2]) variables retrospectively examined. The echocardiographic visit closest to polysomnogram within two years was selected with missing values filled by available values within 6 months. Linear regression assessed the relationship of BMI, AHI, and etCO2 with left ventricular mass index (LVMI) after adjustment of demographics and comorbidities. Echocardiographic measures were logarithm transformed before regression analysis. Coefficients and 95% confidence intervals (CI) were calculated by exponential transformation. The analysis was performed based on an overall significance level of 0.05 using SAS software (version 9.4, Cary, NC).

Results: The total of 832 patients had 24% males, mean age 48.8±12, 60% white, and BMI:49.4±9.5kg/m2. Ejection fraction (%) was 60.0±7.0, and LVMI (g/m2): 80.9±23.7. In adjusted models, LVMI decreased by 2.1% for each 5kg/m2 increase in BMI (coefficient=0.979, 95%CI 0.961–0.997, p=0.022) and increased by 4.3% for each 5 mmHg increase in etCO2 (coefficient=1.043, 95%CI 1.013–1.073, p=0.005). Without adjustment, patients with AHI ≥ 5 had 15.3% higher LVMI than non-OSA group (coefficient=1.153, 95%CI 1.034–1.286, p=0.011) and moderate/severe OSA was associated with a 7.6% higher LVMI than those with AHI<15 (coefficient 1.076, 95%CI 1.003–1.153, p=0.040), but not statistically significant after adjustment.

Conclusion: In obese patients, nocturnal hypoventilation rather than obesity may have adverse influences on left ventricular morphology. Future studies should focus on clarifying whether obesity is truly protective in terms of LV mass, i.e. reflective of paradox versus a product of bias. The potential benefit of identifying/treating SDB in bariatric surgery candidates to mitigate cardiovascular risk also deserves further investigation.

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ASSOCIATION BETWEEN NOCTURNAL HYPOXEMIC BURDEN AND GLUCOSE METABOLISM

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Introduction: To evaluate the association between a novel integrated event-based and hypoxemia-based parameter of polysomnography (PSG), hypoxemic load or HL100, and fasting blood glucose (FBG) and hemoglobin A1c (HbA1c) levels.

Methods: Adult patients, who underwent an in-lab PSG at University of Iowa Hospitals and Clinics with FBG or HbA1c levels were included. Event-based parameter and hypoxemia-based parameter data were derived. HL100, defined as an integrated area of desaturation under 100% oxygen saturation curve during the total sleep time divided by the total sleep time, was calculated by Python software version 3.8.5. Demographic data and glycemic parameters within 1 year prior to PSG(FBG and HbA1c) were retrieved from chart review Spearman correlation analysis and stepwise backward regression analysis were performed to determine independent predictors of FBG and HbA1c levels.

Results: Of the 467 patients underwent an in-lab PSG, 385 had FBG levels and 239 had HbA1c levels. All event-based and hypoxemia-based parameter; including HL100, were significantly correlated to FBG and HbA1c levels. Stepwise backward regression analyses, adjusting for age, sex, body mass index and diabetes status, revealed that log HL100 was significantly related to FBG (B=20.8, p=0.015), and log oxygen desaturation index was found related to HbA1c levels (B=0.273, p=0.037). Other parameters (e.g. apnea hypopnea index, minimum oxygen saturation) were not independently associated with glycemic parameters.

Conclusion: HL100 showed a significant positive correlation with FBG and HbA1c levels and only log HL100 was an independent predictor for FBG levels. This might imply that any degree of desaturation below 100% could result in adverse glucose metabolism. HL100 might be useful for interpretation of sleep studies, risk stratification and patient management purposes in the future.

Support (if any):

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THE RELATIONSHIP BETWEEN SLEEP DISORDERED BREATHING, MARKERS OF VENTRICULAR REPOLARIZATION AND CARDIOVASCULAR MORTALITY

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Introduction: Sleep disordered breathing (SDB) is associated with increased mortality. Obstructive apneas/hypopneas have been associated with an increase in both QTc duration and QT variability. These markers of ventricular repolarization are associated with arrhythmias and death. It is unknown whether SDB-related QTc changes are responsible for the relationship between QTc/QT variability and cardiovascular death (CVD).

Methods: From the Sleep Heart Health Study, we randomly selected 200 subjects in each of four groups based on overall apnea/hypopnea index: those with no SDB and those in either, mild, moderate or severe SDB at baseline, matched for gender, age and BMI. Respiratory-related channels and electrocardiograms (ECG) from each polysomnography were analyzed. QTc was calculated using Bazett's heart rate correction. The following measures of QT variability were obtained: i) standard deviation of QT intervals (SDQT) at 1- and 5-minute intervals and ii) short-term interval QT variability (STVQT) at 5-minute intervals. Cox proportional hazards regression models were used to evaluate potential predictors of CVD.

Results: Twenty-nine subjects were excluded either due to missing data or low quality ECG. The 771 subjects included were 68±10 years of age, half were female. During follow-up, 220 subjects (28.5%) died of CVD among whom, 67 (30.5%) had comorbid severe SDB, 45 (20.5%) had no SDB, and the remaining CVD deaths had mild (47, 21.4%) and moderate 61 (27.7%) SDB. The CVD patients were more likely to be older(p<0.001), hypertensive (p<0.001), diabetic(p<0.001), and had increased SDQT(p<0.001), STVQT(p<0.001) and QTc (0.017). After adjusting for covariates, the presence of mild (p=0.562), moderate(p=0.439) and severe SDB (p=0.912) did not moderate the association between QTc prolongation and CVD. Additionally, mild (p=0.486), moderate(p=0.478) and severe SDB (p=0.849) did not moderate the association between SDQT and CVD. Similarly, mild (p=0.144), moderate(p=0.594) and severe SDB (p=0.508) did not moderate the association between STVQT and CVD. However, QTc, SDQT, STVQT, mild and severe SDB were individually associated with CVD (p=0.004, 0.000, 0.000, 0.014, 0.022, respectively).

Conclusion: SDB was not a factor in the relationship between QTc prolongation/QT variability and CVD.

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THE ASSOCIATION OF QTC AND QT VARIABILITY WITH SEVERITY OF SLEEP DISORDERED BREATHING

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Introduction: The apneas and hypopneas that characterize sleep-disordered breathing (SDB) are associated with QTc prolongation and increased QT variability. There have been mixed results as to whether QTc and QT variability increase with increasing SDB severity. This study assesses whether QTc prolongation and QT variability are likely to increase with increasing severity of SDB in a large multi-center cohort.

Methods: 200 subjects with no SDB and approximately 600 with three levels of SDB (mild, moderate, severe) were randomly selected from the Sleep Heart Health study and matched by age, gender and BMI. SDB was defined as an apnea/hypopnea index ≥5. Respiratory and electrocardiograms (ECG) signals from polysomnography studies were analyzed. Bazett's heart rate correction was used to calculate QTc. QT variability was measured as standard deviation of QT intervals (SDQT) and short-term interval QT variability (STVQT), at 5-minute intervals. Subjects were excluded if there were missing data or low-quality ECG.

Results: Seven hundred and seventy-one subjects (age 68±10 years, 51% female, 92% Caucasian) were included. One hundred and sixty-five subjects had no SDB, 235 mild, 195 moderate and 176 had severe SDB. The mean (SD) QTc was 422(29), 411(26), 419 (34) and 418 (36) ms for the no SDB, mild, moderate, and severe SDB groups, respectively (p=0.017). The mean (SD) STVQT was 7 (9), 11 (16), 8 (9) and 9 (11) for the no SDB, mild, moderate severe SDB groups, respectively (p=<0.001). The mean (SD) STVQT was 3 (2), 4 (4), 4 (3) and 4(4) for the no SDB, mild, moderate severe SDB groups, respectively (p=<0.001). There was no statistically linear relationship between QT prolongation or QT variability and SBD severity.

Conclusion: QTc duration and QT variability were not increased with SDB severity.

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CARDIOVASCULAR AND METABOLIC RISK IN PATIENTS WITH SUSPECTED COMORBID INSOMNIA AND OBSTRUCTIVE SLEEP APNEA (COMISA)

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Introduction: Only few studies looked for a possible association of cardiovascular disorders (CVD), in comorbid insomnia with obstructive sleep apnea (COMISA) even though this is a relevant topic in order to prevent one of the major causes of morbimortality. The present study aimed to investigate the association of insomnia symptoms in patients at risk for obstructive sleep apnea in terms of prevalence and clinical interactions and to evaluate the risk of CVD in patients with a risk for COMISA.

Methods: This is a cross-sectional study. All medical records with data such as age, sex, height, weight and BMI, time to sleep, time to wake up, total sleep time, the Epworth Sleepiness Scale (ESS), STOP-BANG Questionnaires were studied. Insomnia and comorbidities were also investigated, and the patientsanswered yes or no to systemic arterial hypertension, diabetes, CVD.

Results: 685 patients were enrolled on the present study. We observed that the mild, moderate, and high risk for COMISA presented progressively increasing levels for the frequency of hypertension, diabetes, and CVD. A binary logistic regression was performed to assess whether risk for COMISA could be a predictor for CVD, and it was found that the model containing risk for COMISA was statistically significant: [x2(1)=5.273;p<0.021, R2 Negelkerke=0.014]. Risk for COMISA presented itself as a significant predictor for CVD (OR=1.672; 95% CI=1.079–2.592).

Conclusion: There was an increased frequency of associated comorbidities such as CVD, systemic arterial hypertension, and diabetes, according to the mild, moderate, or high risk. These findings highlight the need for a cardiometabolic evaluation in patients with this comorbid condition which may impact prognosis and therapeutic success.

Support (if any):

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SOLRIAMFETOL TITRATION & ADMINISTRATION (START): CHARACTERISTICS OF PATIENTS WITH NARCOLEPSY AND SOLRIAMFETOL PRESCRIBER RATIONALE

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Introduction: Pharmacotherapy for excessive daytime sleepiness (EDS) associated with narcolepsy is diverse, with factors such as efficacy, side effects, and tolerance influencing treatment decisions. Solriamfetol (Sunosi®), a dopamine/norepinephrine reuptake inhibitor, is approved (US and EU) to treat EDS in adults with narcolepsy (75–150 mg/day) or obstructive sleep apnea (OSA) (37.5–150 mg/day). This study characterized real-world patients with narcolepsy starting solriamfetol and prescribers' rationales for initiating treatment.
Methods: This virtual, descriptive study included a quantitative retrospective patient chart review among US-based physicians prescribing solriamfetol. Target enrollment was 25 physicians treating patients with EDS associated with OSA or narcolepsy. Treatment initiation was classified as de novo (no EDS medication prior to solriamfetol), transition (switched/switching from existing EDS medications onto solriamfetol), or add-on (adding solriamfetol to current EDS medication).
Results: Twenty-six physicians participated. Seventy patients with narcolepsy were analyzed (type 1, n=24; type 2, n=46; mean±SD age, 40±11 years; 57% female; 6 also had OSA); EDS was primarily moderate (59%) or severe (36%). Twenty-two patients (31%) were obese (BMI≥30); other common physician-reported comorbidities were migraine headaches (n=12, 17%), depression (n=10, 14%), and cardiovascular disorders (n=10, 14%). Solriamfetol initiation was de novo for 19 (27%) patients, transition for 31 (44%), and add-on for 20 (29%). Patients transitioning to solriamfetol were taking 1 (29/31, 94%) or 2 (2/31, 7%) prior EDS medications; patients adding solriamfetol were taking 1 (16/20, 80%), 2 (3/20, 15%) or 3 (1/20, 5%). Most patients transitioning to solriamfetol were taking wake-promoting agents (22/31, 71%); patients adding solriamfetol were most frequently taking sodium oxybate (11/20, 55%). Solriamfetol's efficacy profile was the primary reason prompting the discussion to prescribe solriamfetol de novo (12/19, 63%); need for better efficacy/augmenting effects of other medications was the primary reason for transitioning (18/31, 58%) and add-on therapy (19/20, 95%). At data collection, 63 (90%) patients were still on a stable solriamfetol dose. The most common reasons for discontinuing solriamfetol were lack of efficacy (n=3) and side effects (n=3).
Conclusion: Efficacy and the need for improved efficacy over existing medication(s) were key considerations for physicians prescribing solriamfetol treatment to patients with narcolepsy in clinical practice.
Support (if any): Jazz Pharmaceuticals

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SOLRIAMFETOL TITRATION & ADMINISTRATION (START): DOSING AND TITRATION STRATEGIES IN PATIENTS WITH NARCOLEPSY STARTING SOLRIAMFETOL

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Introduction: Solriamfetol (Sunosi®), a dopamine/norepinephrine reuptake inhibitor, is approved (US and EU) to treat excessive daytime sleepiness (EDS) in adults with narcolepsy (75–150 mg/day) or obstructive sleep apnea (OSA) (37.5–150 mg/day). Previous research examined the use of solriamfetol in clinical trial settings but research in real-world settings was not previously conducted. This study characterized real-world dosing and titration with solriamfetol.
Methods: This virtual, descriptive study included a quantitative retrospective patient chart review among US-based physicians prescribing solriamfetol. Target enrollment was 25 physicians treating patients with EDS associated with OSA or narcolepsy. Titration strategies were classified as de novo (no prior EDS medication), transition (switched/switching from existing EDS medications onto solriamfetol), or add-on (adding solriamfetol to current EDS medication).
Results: Twenty-six physicians participated. Seventy patients with narcolepsy were analyzed (type 1, n=24; type 2, n=46; mean±SD age, 40±11 years; 57% female; 6 also had OSA); EDS was primarily moderate (59%) or severe (36%). Solriamfetol initiation was de novo for 19 (27%) patients, transition for 31 (44%), and add-on for 20 (29%). Most patients (86%) started solriamfetol at 75 mg; 11% and 3% started at 37.5 mg and 150 mg, respectively. The final/stable dose was 150 mg for 76% (53/70) of patients and 75 mg for 24% (17/70). Most patients (67%) had 1 dose adjustment to reach their final dose; 4% had 2 adjustments, 4% had 3 adjustments, and 24% had none. Mean±SD time to reach a stable dose was 15.1±11.8 days overall, 19.4±9.3 days with de novo treatment, 15.0±13.7 days for transition, and 11.9±8.6 days for add-on. Physicians most frequently considered EDS severity (44% of patients) when titrating. Among patients transitioning, 14/22 (64%) taking a wake-promoting agent (WPA) discontinued it abruptly while 5/9 (56%) taking a stimulant were tapered off. Physicians were overall likely (n=33, 47%) or very likely (n=30, 43%) to recommend their approach for similar patients.
Conclusion: In a real-world study, the majority of physicians prescribing solriamfetol for patients with narcolepsy started at the 75-mg dose, tapered stimulants but abruptly discontinued WPAs, and made 1 adjustment to reach a stable dose across 15 days on average.
Support (if any): Jazz Pharmaceuticals

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NEUROANATOMICAL AND NEUROFUNCTIONAL CORRELATES OF UNEXPLAINED EXCESSIVE DAYTIME SLEEPINESS

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Introduction: Excessive daytime sleepiness (EDS) frequently presents as a secondary symptom, but some experience EDS in the absence of an explanatory medical condition, psychiatric illness, sleep disorder, or medication/substance use. The neurobiology underlying unexplained EDS (uEDS) is poorly understood, which contributes to the existing limitations in uEDS classification, assessment, and treatment. This investigation was designed to identify potential neuroanatomical and neurofunctional correlates of uEDS.
Methods: Data were acquired from the open-access Stockholm Sleepy Brain (SSB) Project, which included either young (20–30 years old) or older (65–75 years old) adults. SSB criteria ruled out common EDS explanations. A uEDS sample (N = 18; Percentage Female = 33%; Percentage Young = 33%) was established using Epworth Sleepiness Scale (ESS) ≥ 11. Age-and-sex matched controls without EDS (noEDS) were identified. T1-weighted MRI and resting-state fMRI (rs-fMRI) data were compiled for each subject, as well as depression,

anxiety, and global health self-ratings. Processing pipelines were performed on T1-weighted and rs-fMRI data. Neuroanatomical analyses compared groups using voxel-based morphometry and across gray matter (GM), white matter (WM), and cerebral spinal fluid volume. Threshold free cluster enhancement was used across all neuroanatomical comparisons. For neurofunctional analyses, seed-based connectivity analysis was performed with a seed placed in the left hemisphere of the medial prefrontal cortex (MNI coordinates: 2 -46 12). Fischer Z-transformed functional connectivity maps were compared across groups. Depression, anxiety, and global health scores were included as covariates and corrections were applied for multiple comparisons, across all analyses.

Results: Group characteristics were comparable, except for ESS. Significantly increased GM volume (middle occipital gyrus and precuneus) was associated with uEDS, relative to noEDS. Robust, bilateral increases in WM matter (thalamus, cerebellum, and middle frontal gyrus) were observed for uEDS, relative to noEDS. No significant group differences were observed in rs-fMRI.

Conclusion: Significant neuroanatomical alterations were associated with uEDS that included increases in both GM and WM. These findings converge on previous research associating anatomical differences within the default mode network with uEDS. Future research using more sensitive quantitative measures of WM is warranted.

Support (if any): This project was supported by a National Institute Nursing Research grant (NR018288).

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SOLRIAMFETOL TITRATION & ADMINISTRATION (START): PHYSICIAN TITRATION STRATEGIES IN A HYPOTHETICAL PATIENT WITH NARCOLEPSY

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Introduction: Solriamfetol (Sunosi®), a dopamine/norepinephrine reuptake inhibitor, is approved (US and EU) to treat excessive daytime sleepiness (EDS) in adults with narcolepsy (75–150 mg/day) or obstructive sleep apnea (OSA) (37.5–150 mg/day). Patient characteristics, comorbidities, and other EDS medications can influence treatment strategies. To understand factors physicians consider when initiating solriamfetol, this study analyzed titration strategies for a hypothetical patient.

Methods: This virtual, descriptive, cross-sectional, qualitative survey enrolled US-based physicians treating patients with EDS due to OSA and/or narcolepsy. Responses to 4 open-ended questions regarding a hypothetical patient were recorded. Patient scenario: 32-year-old woman with narcolepsy (Epworth Sleepiness Scale score=8) using an amphetamine stimulant (35 mg/day) and sodium oxybate (6 g/night) for 6 months and occasionally experiencing non-use-limiting but bothersome adverse events (AEs) with the stimulant. Content analysis of the recordings identified themes in the responses; a trained linguist captured language choices/patterns.

Results: Twenty-six physicians (neurologists, n=7 [27%]; internists/family practitioners, n=7 [27%]; pulmonologists, n=6 [23%]; psychiatrists, n=5 [19%]; otolaryngologists, n=1 [4%]) representing 781 patients on stable solriamfetol doses participated; 19 (73%) were board-certified in sleep disorders. Physicians had been treating narcolepsy a mean 15.7±6.6 years. Most (21 [81%]) thought the patient appropriate for solriamfetol, 3 (12%) thought not appropriate, and 2 (8%) thought appropriateness depended on other factors. Sixteen physicians (62%) suggested adjusting her stimulant, 3 (12%) the stimulant and sodium oxybate, and 1 (4%) neither. Nineteen (73%) would titrate solriamfetol per the label, with 13 (50%) aiming for 75 mg/day and 8 (31%) for 150 mg/day. Physicians emphasized stopping the stimulant before starting solriamfetol: 10 (39%) would taper down before starting solriamfetol, 7 (27%) while starting solriamfetol, and 1 (4%) while aiming to eventually switch; 8 (31%) would discontinue abruptly. Nineteen physicians (73%) would not change their approach if the stimulant dose were 60 mg/day. Most clinicians would change their approach if AEs occurred while starting solriamfetol by taking a slower or more gradual approach, while some would titrate off the stimulant more aggressively.

Conclusion: Physicians considered existing medications and potential AEs in their titration strategy when initiating solriamfetol.

Support (if any): Jazz Pharmaceuticals

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EFFICACY AND SAFETY OF ONCE- AND TWICE-NIGHTLY DOSING OF LOWER-SODIUM OXYBATE IN ADULTS WITH IDIOPATHIC HYPERSOMNIA

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Introduction: Idiopathic hypersomnia (IH) is a rare central hypersomnolence disorder. In a randomized, controlled study of lower-sodium oxybate (LXB; Xywav™) in adults with IH (NCT03533114), significant differences for LXB compared with placebo were observed in Epworth Sleepiness Scale (ESS; primary efficacy endpoint), self-reported Patient Global Impression of Change (PGIc), and IH Severity Scale (IHSS; key secondary endpoints). In this clinical study, investigators were permitted to initiate LXB dosing on a once-nightly or twice-nightly regimen.

Methods: Eligible participants aged 18–75 years began LXB treatment, administered once or twice nightly during an open-label treatment/titration and optimization period (OLTTOP; 10–14 weeks); dose amount/regimen could be adjusted during this period. Participants next entered a 2-week, open-label, stable-dose period (SDP), then were randomized to placebo or to continue LXB treatment during a 2-week, double-blind, randomized withdrawal period (DBRWP). P values are nominal for this exploratory analysis.

Results: Of 154 enrolled participants, 40 (26%) initiated LXB treatment on a once-nightly regimen. In the efficacy population (n=115), 27 participants were on a once-nightly regimen during SDP (48.1% of whom initiated treatment once nightly during OLTTOP) and 88 participants were on a twice-nightly regimen during SDP (86.4% of whom initiated treatment twice nightly during OLTTOP). During SDP, median (min, max) LXB total dose was 4.5 (2.5, 6) g/night (once-nightly group) and 7.5 (4.5, 9) g/night (twice-nightly group). ESS scores worsened in participants randomized to placebo vs those continuing LXB in the once-nightly group (n=11 and n=15, respectively; LS mean difference [95% CI]: −4.93 [−7.41, −2.46]; P=0.0004) and twice-nightly group (n=47 and n=41, respectively; LS mean difference [95% CI]: −7.44 [−9.15, −5.72]; P<0.0001). Worsening was also observed in PGIc (once-nightly: 81.8% [placebo] vs 26.7% [LXB]; P=0.0077; twice-nightly: 89.4% [placebo] vs 19.5% [LXB]; P<0.0001) and IHSS score (estimated median difference [95% CI], once-nightly: −9.00 [−16.0, −3.0]; P=0.0028; twice-nightly: −12.00 [−15.0, −8.0]; P<0.0001). Common adverse events included nausea (21.4%), headache (16.2%), anxiety (14.9%), dizziness (11.7%), insomnia (11.7%), and vomiting (10.4%).

Conclusion: The efficacy and safety of LXB in IH were demonstrated for both once-nightly and twice-nightly regimens. The majority of participants initiated and remained on a twice-nightly regimen.
Support (if any): Jazz Pharmaceuticals

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TIMING AND DURATION OF ADVERSE EVENTS IN A CLINICAL TRIAL OF LOWER-SODIUM OXYBATE IN PARTICIPANTS WITH NARCOLEPSY WITH CATAPLEXY

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Introduction: This analysis evaluated treatment-emergent adverse events (TEAEs) during a double-blind, placebo-controlled, randomized withdrawal trial (NCT03030599) of lower-sodium oxybate (LXB; Xywav™), an FDA-approved treatment for excessive daytime sleepiness or cataplexy in narcolepsy.
Methods: At study entry, participants were taking sodium oxybate (SXB) alone, SXB with other anticataplectics, other anticataplectics alone, or were anticataplectic treatment-naive. Participants taking SXB transitioned to the same LXB dose (gram-for-gram); oxybate-naive participants initiated LXB (4.5 g/night). TEAEs were analyzed in the safety population (N=201, received ≥1 study drug dose) during a 12-week open-label optimized treatment/titration period (while other anticataplectics were tapered/discontinued) and subsequent 2-week stable-dose period (SDP). TEAE duration was defined as time from TEAE start to end date (or end of SDP, if TEAE end date was unrecorded).
Results: LXB-emergent TEAEs varied by treatment at entry. Anticataplectic treatment-naive participants reported TEAEs including headache (n=36/90, 40%; median duration [range]=1 [1–76] day), nausea (n=19/90, 21%; duration=9 [1–37] days), and dizziness (n=15/90, 17%; duration=10 [1–117] days); peak incidence was week 2 (n=8/89, 9%) for headache, week 3 (n=3/88, 3%) for dizziness, and week 1 (n=6/90, 7%) for nausea. Anticataplectic treatment-naive participants (n=13/90, 14%) also reported decreased appetite, with relatively long duration (58 [2–358] days). Participants taking SXB alone reported TEAEs including headache (n=17/52, 33%; duration=1 [1–122] day) and diarrhea (n=4/52, 8%; duration=41 [2–101] days); peak headache incidence was week 4 (n=4/52, 8%); diarrhea had no peak. Participants taking other anticataplectics alone reported TEAEs including headache (n=14/36, 39%; duration=1 [1–94] day), nausea (n=9/36, 25%; duration=3 [1–16] days), and dizziness (n=9/36, 25%; duration=4 [1–29] days); peak incidence was week 1 (n=3/36, 8%) for headache, week 6 (n=2/32, 6%) for nausea, and week 4 (n=3/33, 9%) for dizziness. One participant taking SXB with other anticataplectics (n=1/23, 4%) reported headache in weeks 1–2 and 4; one reported nausea (4%) persisting from week 1 to 8. Overall, study discontinuations attributed to TEAEs were 20/57 (35%).
Conclusion: Most TEAEs with LXB treatment occurred early, were consistent with the known SXB safety profile, and were relatively short-lived (except decreased appetite). Participants previously taking SXB reported fewer TEAEs than oxybate-naive participants.
Support (if any): Jazz Pharmaceuticals, Inc.

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EFFECT OF LOWER-SODIUM OXYBATE ON SLEEP INERTIA IN IDIOPATHIC HYPERSOMNIA IN A DOUBLE-BLIND, RANDOMIZED WITHDRAWAL STUDY

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Introduction: Idiopathic hypersomnia (IH) is a rare central hypersomnolence disorder characterized by excessive daytime sleepiness. A common feature is sleep inertia, which is prolonged difficulty waking up accompanied by confusion, disorientation, poor motor coordination, and repeated returns to sleep. Sleep inertia is burdensome to patients, resulting in missed work or school, and patients may be dependent on others to wake them. No treatment is currently approved for IH. The efficacy and safety of lower-sodium oxybate (LXB; Xywav™), a novel oxybate treatment with 92% less sodium than sodium oxybate (Xyrem®), was evaluated in a phase 3 study (NCT03533114) in adults with IH. We focus here on the drug effect on sleep inertia.
Methods: Eligible participants aged 18–75 years with IH began LXB treatment with an open-label treatment titration and optimization period (OLTTOP; 10–14 weeks), followed by a 2-week, open-label, stable-dose period (SDP). Participants were randomized to placebo or to continue LXB treatment during a 2-week, double-blind, randomized withdrawal period (DBRWP). The primary efficacy endpoint was change in Epworth Sleepiness Scale score. The visual analog scale for sleep inertia (VAS-SI) was included as an exploratory endpoint. The VAS-SI, administered daily during the last 2 weeks of screening before baseline, SDP, and DBRWP, is a self-reported retrospective measure of difficulty awakening each morning using a 100-mm line with anchors 0 (very easy) and 100 (very difficult).
Results: The safety population included 154 participants (mean±SD age, 40±14 years; 68% female); modified intent-to-treat population, n=115. VAS-SI scores gradually decreased from week 2 of screening (mean±SD, 56.6±25.1) to week 2 of SDP (29.0±20.8). During week 2 of DBRWP, VAS-SI scores worsened in participants randomized to placebo (n=59) compared with maintenance of improvement in participants continuing LXB treatment (n=56); LS mean difference (95% CI) in change from SDP, −22.2 (−29.7, −14.8); P<0.0001 (nominal). Common adverse events included nausea (21.4%), headache (16.2%), anxiety (14.9%), dizziness (11.7%), insomnia (11.7%), and vomiting (10.4%).
Conclusion: Sleep inertia improved with LXB treatment and significant differences were seen between placebo and LXB after DBRWP. The overall safety profile in participants with IH is consistent with that of LXB in narcolepsy.
Support (if any): Jazz Pharmaceuticals, Inc

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REST-ON: EFFICACY OF FT218 FOR DAYTIME SLEEPINESS, SLEEP QUALITY, HALLUCINATIONS, AND SLEEP PARALYSIS IN PATIENTS WITH NARCOLEPSY

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Introduction: Sodium oxybate (SO) is an effective treatment for narcolepsy; however, currently available formulations must be taken twice nightly. FT218 is an investigational once-nightly controlled-release

formulation of SO. Here, we evaluated the efficacy of FT218 on excessive daytime sleepiness (EDS), self-reported sleep quality/refreshing nature of sleep, sleep paralysis (SP), and hypnagogic hallucinations (HH) in patients with narcolepsy.

Methods: In this phase 3, randomized, double-blind, placebo-controlled, multicenter study, patients aged ≥16 years with narcolepsy type 1 or 2 were randomized 1:1 to receive FT218 or matching placebo: 4.5 g/night (1 week), 6.0 g/night (2 weeks), 7.5 g/night (5 weeks), and 9.0 g/night (5 weeks). Secondary efficacy endpoints included EDS using the Epworth Sleepiness Scale (ESS), sleep quality/refreshing nature of sleep using a visual analog scale (VAS), and SP and HH using a sleep symptom diary.

Results: A total of 212 patients were randomized and received study medication (FT218, n=107; placebo, n=105). Patients receiving FT218 had significant improvement vs placebo in EDS on the ESS: LS mean difference on ESS score between FT218 and placebo was −3.86 for 9.0 g (week 13), −3.16 for 7.5 g (week 8), and −2.06 for 6.0 g (week 3) (all P<0.001). Sleep quality/refreshing nature of sleep on VAS was also significantly improved with FT218 vs placebo (P<0.001 for all doses). Patients receiving FT218 reported less SP vs placebo (P<0.05 at all doses). Baseline values for HH were low in both treatment groups; HH was similar for both treatment groups at all study visits. The most common adverse reactions were nausea, dizziness, enuresis, headache, decreased appetite, and vomiting.

Conclusion: At all evaluated doses, treatment with FT218 significantly improved EDS, sleep quality/refreshing nature of sleep, and SP vs placebo. FT218 was generally well tolerated; the most common adverse events were consistent with known SO side effects.

Support (if any): Avadel Pharmaceuticals.

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PIVOTAL PHASE 3 STUDY OF FT218, A ONCE-NIGHTLY SODIUM OXYBATE FORMULATION, IN PATIENTS WITH NARCOLEPSY: REST-ON PRIMARY RESULTS

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Introduction: Sodium oxybate (SO) is an effective treatment for patients with narcolepsy; however, currently available SO formulations require twice-nightly dosing. The purpose of this study was to evaluate efficacy and safety of FT218, an investigational once-nightly controlled-release SO formulation, for the treatment of excessive daytime sleepiness and cataplexy in patients with narcolepsy types 1 (NT1) and 2 (NT2).

Methods: This was a randomized, double-blind, placebo-controlled, multicenter study in patients with narcolepsy ≥16 years old. Patients were randomized 1:1 to receive FT218 or matching placebo: 4.5 g/night for 1 week, 6.0 g/night for 2 weeks, 7.5 g/night for 5 weeks, and 9.0 g/night for 5 weeks (maximum treatment duration, 13 weeks). Coprimary endpoints were mean sleep latency (minutes) on maintenance of wakefulness test (MWT), Clinical Global Impression-Improvement (CGI-I) of sleepiness, and weekly number of cataplexy attacks (NCAs; NT1 only).

Results: A total of 212 patients were randomized and received study treatment (FT218, n=107; placebo, n=105). FT218 showed significant (P<0.001) improvement vs placebo in mean sleep latency on MWT for all evaluated doses; LS mean difference (minutes) between FT218 and placebo was 6.13 at 9.0 g (week 13), 6.21 at 7.5 g (week 8), and 4.98 at 6.0 g (week 3). A higher proportion of patients receiving FT218 were much/very much improved on CGI-I vs placebo (72% vs 31.6% at 9.0 g; 62.6% vs 22.8% at 7.5 g; and 40.1% vs 6.1% at 6.0 g; all P<0.001). LS mean difference between FT218 and placebo in mean weekly NCAs was significant (P<0.001) for all doses: −6.65 at 9.0 g, −6.27 at 7.5 g, and −4.83 at 6.0 g. The most common adverse reactions were nausea, vomiting, headache, dizziness, enuresis, and decreased appetite.

Conclusion: All evaluated doses of FT218 showed significant improvement vs placebo in mean sleep latency on MWT, CGI-I, and weekly NCAs. FT218 was generally well tolerated and the most common adverse events were consistent with known side effects of SO.

Support (if any): Avadel Pharmaceuticals.

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EFFICACY OF FT218 ON POLYSOMNOGRAPHIC MEASURES OF SLEEP CONTINUITY IN PATIENTS WITH NARCOLEPSY: RESULTS FROM THE REST-ON TRIAL

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Introduction: Disturbed nocturnal sleep (DNS) is a common symptom in patients with narcolepsy, characterized by fragmented sleep, including frequent brief nightly awakenings. Sodium oxybate (SO) is an effective treatment for narcolepsy; however, currently available formulations must be taken twice nightly. FT218 is an investigational once-nightly controlled-release formulation of SO. Here, we evaluated the efficacy of FT218 on polysomnographic (PSG) measures of DNS and number of arousals (NAs) in patients with narcolepsy types 1 and 2.

Methods: This was a randomized, double-blind, placebo-controlled, multicenter study. Patients with narcolepsy aged ≥16 years were randomized 1:1 to receive FT218 or matching placebo: 4.5 g/night for 1 week, 6.0 g/night for 2 weeks, 7.5 g/night for 5 weeks, and 9.0 g/night for 5 weeks. Secondary endpoints included PSG measurements of DNS (defined as shifts to wake/N1 from N1, N2, N3, and REM) and NAs (defined per AASM Scoring Manual guidelines [v2.6]).

Results: Patients receiving FT218 had significant improvements vs placebo in DNS; the LS mean difference between FT218 and placebo was −22.63 for 9.0 g (week 13), −17.70 for 7.5 g (week 8), and −11.00 for 6.0 g (week 3) (all P<0.001). Patients receiving FT218 also had significant reduction in number of NAs vs placebo; the LS mean difference between FT218 and placebo for NAs was −23.68 (P<0.001) for 9.0 g, −19.41 (P<0.001) for 7.5 g, and −11.29 (P=0.021) for 6.0 g. The most common adverse reactions were nausea, dizziness, enuresis, headache, decreased appetite, and vomiting.

Conclusion: FT218 at all evaluated doses showed significant reduction in DNS and number of NAs vs placebo for all doses of FT218 evaluated. FT218 was generally well tolerated; the most common adverse events were consistent with known SO side effects. FT218 could offer a new once-nightly treatment option for DNS in patients with narcolepsy as demonstrated by PSG measures.

Support (if any): Avadel Pharmaceuticals.

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EFFICACY OF FT218, A ONCE-NIGHTLY SODIUM OXYBATE FORMULATION, BY NARCOLEPSY SUBTYPE: A POST HOC ANALYSIS FROM THE REST-ON STUDY

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Introduction: FT218 is an investigational, once-nightly, controlled-release formulation of sodium oxybate for the treatment of narcolepsy. The purpose of this post hoc analysis of the REST-ON study was to evaluate the effect of FT218 on measures of excessive daytime sleepiness (EDS) in patients with narcolepsy subtypes 1 (NT1) and 2 (NT2).
Methods: This was a randomized, double-blind, placebo-controlled, multicenter study in patients with narcolepsy ≥16 years old. Patients were stratified by narcolepsy subtypes and randomized 1:1 to receive FT218 or matching placebo: 4.5 g/night for 1 week, 6.0 g/night for 2 weeks, 7.5 g/night for 5 weeks, and 9.0 g/night for 5 weeks (maximum treatment duration, 13 weeks). Assessments of EDS included mean sleep latency (minutes) on maintenance of wakefulness test (MWT) and Clinical Global Impression-Improvement (CGI-I) in sleepiness.
Results: A total of 190 patients were included in the modified intent-to-treat population (NT1: FT218, n=72; placebo, n=73; NT2: FT218, n=21, placebo, n=24). Patients with NT1 or NT2 receiving FT218 had significant improvement in MWT. LS mean difference in mean sleep latency (minutes) vs placebo for NT1 was 5.97 for 9.0 g (week 13), 7.02 for 7.5 g (week 8), and 4.89 for 6.0 g (week 3; all P<0.001), and for NT2, 6.27 for 9.0 g (P=0.020), 4.01 for 7.5 g (P=0.162), and 5.33 for 6.0 g (P=0.020). A higher proportion of NT1 patients receiving FT218 had significant improvement on CGI-I vs placebo (9.0 g: 75.5% vs 35.9%; 7.5 g: 66.9% vs 27.9%; 6.0 g: 39.9% vs 7.8%; all P<0.001). A higher number of NT2 patients receiving FT218 were consistently rated as much/very much improved vs placebo, based on descriptive statistics. FT218 was generally well tolerated.
Conclusion: FT218 had similar efficacy on EDS at evaluated doses in NT1 and NT2, with improvement in MWT and CGI-I greater than placebo. FT218 may provide effective treatment for EDS in patients with narcolepsy, with or without cataplexy.
Support (if any): Avadel Pharmaceuticals.

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EFFICACY OF FT218, A ONCE-NIGHTLY SODIUM OXYBATE FORMULATION, BY STIMULANT USE: A POST HOC ANALYSIS FROM THE REST-ON STUDY

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Introduction: FT218 is an investigational, once-nightly, controlled-release formulation of sodium oxybate for the treatment of narcolepsy. The purpose of this post hoc analysis of the REST-ON study was to evaluate the effect of FT218 on measures of excessive daytime sleepiness (EDS) in patients with narcolepsy with or without stimulant use.
Methods: This was a randomized, double-blind, placebo-controlled, multicenter study in patients with narcolepsy ≥16 years old. Patients were stratified by stimulant use and randomized 1:1 to receive FT218 or matching placebo: 4.5 g/night for 1 week, 6.0 g/night for 2 weeks, 7.5 g/night for 5 weeks, and 9.0 g/night for 5 weeks (maximum treatment duration, 13 weeks). Assessments of EDS included mean sleep latency (minutes) on maintenance of wakefulness test (MWT) and Clinical Global Impression-Improvement (CGI-I) in sleepiness.
Results: A total of 190 patients were included in the modified intent-to-treat population (stimulants: FT218, n=66; placebo, n=53; no stimulants: FT218, n=31, placebo, n=40). Overall, 63% of patients were on concomitant stimulants. Patients receiving FT218 had significant improvement vs placebo in MWT regardless of stimulant use. LS mean difference in mean sleep latency vs placebo for stimulant use was 5.99 for 9.0 g (week 13), 5.51 for 7.5 g (week 8), and 5.35 for 6.0 g (week 3; all P<0.001). For no stimulant use, LS mean difference was 6.28 for 9.0 g (P=0.001), 7.14 for 7.5 g (P<0.001), and 4.19 for 6.0 g (P=0.007). More patients receiving FT218 rated sleepiness as much/very much improved on CGI-I vs placebo (stimulant use: 9.0 g, 80.5% vs 35.3%, odds ratio [OR] 7.55; 7.5 g, 66.3% vs 26.5%, OR 5.44; 6.0 g, 39.8% vs 4.4%, OR 14.27 [all P<0.001]; no stimulant use: 9.0 g, 55.1% vs 27.2%, OR 3.29 [P=0.047]; 7.5 g, 54.5% vs 17.5%, OR 5.64 [P=0.006]; 6.0 g, 40.0% vs 7.7%, OR 8.04 [P=0.003]). FT218 was generally well tolerated.
Conclusion: FT218 had similar efficacy on EDS at all evaluated doses in narcolepsy patients with or without stimulant use, with improvement over placebo on MWT and CGI-I. FT218 may provide effective treatment for EDS in patients with narcolepsy regardless of stimulant use.
Support (if any): Avadel Pharmaceuticals.

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WEIGHT LOSS WITH FT218, A ONCE-NIGHTLY SODIUM OXYBATE FORMULATION FOR THE TREATMENT OF NARCOLEPSY: POST HOC ANALYSIS FROM REST-ON

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Introduction: Patients with narcolepsy are more likely to be obese compared with healthy controls. FT218 is an investigational once-nightly sodium oxybate formulation for the treatment of narcolepsy. Here, we report on changes in weight-related clinical values with FT218 treatment in patients with narcolepsy.
Methods: This was a randomized, double-blind, placebo-controlled multicenter study in patients with narcolepsy ≥16 years old. Patients were not excluded based on baseline weight or body mass index (BMI). Patients were randomized 1:1 to receive FT218 or matching placebo: 4.5 g/night for 1 week, 6.0 g/night for 2 weeks, 7.5 g/night for 5 weeks, and 9.0 g/night for 5 weeks (maximum treatment duration, 13 weeks). Weight and BMI were measured at baseline and study end. LS mean difference in BMI between FT218 and placebo was analyzed using analysis of covariance.
Results: A total of 107 patients received FT218 and 105 patients received placebo. At baseline, mean (SD) weight was 81.2 (20.8) kg in the FT218 treatment group and 82.1 (22.5) kg in the placebo treatment group. At end of study (week 13), mean (SD) weight was 80.9 (21.9) kg in the FT218 treatment group and 82.25 (21.6) in the placebo treatment group. At week 13, mean (SD) change in weight from baseline was –1.29 (3.6) kg for FT218 and 0.19 (2.6) kg for placebo; 17.5% of patients receiving FT218 vs 3.8% of patients receiving placebo had ≥5% weight loss. At baseline, mean (SD) BMI was 28.1 (7.8) kg/m2 in the FT218 treatment group and 28.2 (6.6) kg/m2 in the placebo treatment group. At study end (week 13), LS mean (SE) change from baseline in BMI was −0.51 (0.13) kg/m2 for patients receiving FT218 and 0.08 (0.13) kg/m2 for patients receiving placebo (LS mean difference

[95% CI], −0.59 [−0.95 to −0.23]; P=0.001). FT218 was generally well tolerated.
Conclusion: Patients receiving FT218 experienced a significantly greater decrease in weight and BMI vs placebo. These results suggest that treatment with once-nightly FT218 may provide weight-related benefit for patients with narcolepsy and comorbid weight gain.
Support (if any): Avadel Pharmaceuticals

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PLACEBO-CONTROLLED, DOUBLE-BLIND, RANDOMIZED WITHDRAWAL STUDY OF LOWER-SODIUM OXYBATE IN ADULTS WITH IDIOPATHIC HYPERSOMNIA

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Introduction: Idiopathic hypersomnia (IH) is a rare central hypersomnolence disorder characterized by excessive daytime sleepiness, prolonged nighttime sleep, and sleep inertia. No US/EU medication is approved for treatment of IH. Lower-sodium oxybate (LXB; Xywav™; previously designated JZP-258) is a novel oxybate treatment with 92% less sodium than sodium oxybate (Xyrem®). The efficacy and safety of LXB was evaluated in adults with IH.
Methods: Eligible participants aged 18–75 years with IH began once- or twice-nightly LXB treatment entering an open-label titration and optimization period (10–14 weeks), followed by a 2-week, open-label, stable-dose period (SDP); they were then randomized to placebo or to continue LXB treatment during a 2-week, double-blind, randomized withdrawal period (DBRWP). The primary efficacy endpoint was change in Epworth Sleepiness Scale (ESS) score; key secondary endpoints were proportion of participants who reported worsening (minimally/much/very much worse) on Patient Global Impression of Change (PGIc) and change in Idiopathic Hypersomnia Severity Scale (IHSS) score, all from end of SDP to end of DBRWP.
Results: The study enrolled 154 participants (mean±SD age, 40±14 years; 68% female; mean±SD ESS, 16±3.6); mean±SD dose was 6.0±1.6 g/night. Mean±SD ESS score (n=115) decreased over open-label titration/optimization (15.7±3.8 at baseline, 9.8±4.5 at week 4, and 6.1±4.0 at the end of the SDP). At the end of the DBRWP, significant worsening was observed in participants randomized to placebo, compared with maintenance of improvement in participants randomized to continue LXB, in ESS scores (n=115; LS mean difference [95% CI] in change from SDP, −6.51 [−7.99, −5.03]; P<0.0001), in the PGIc (88.1% for placebo vs 21.4% for LXB; P<0.0001), and in IHSS scores (estimated median difference [95% CI], −12.00 [−15.0, −8.0]; P<0.0001). Common adverse events (AEs) included nausea (21.4%), headache (16.2%), anxiety (14.9%), dizziness (11.7%), insomnia (11.7%), and vomiting (10.4%). Serious AEs occurred in 4 participants (non-cardiac chest pain, rhabdomyolysis, syncope, and nephrolithiasis/pyelonephritis); none were reported related to study drug.
Conclusion: In participants with IH, LXB demonstrated a clinically meaningful effect on excessive daytime sleepiness, self-reported global change, and overall IH symptom severity. The overall safety profile was consistent with that of LXB in narcolepsy.
Support (if any): Jazz Pharmaceuticals

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EFFICACY OF LOWER-SODIUM OXYBATE ON IDIOPATHIC HYPERSOMNIA, MEASURED BY THE IDIOPATHIC HYPERSOMNIA SEVERITY SCALE

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Introduction: Idiopathic hypersomnia (IH) is a rare central hypersomnolence disorder with no approved treatment, characterized by excessive daytime sleepiness, prolonged sleep time, and sleep inertia. The Idiopathic Hypersomnia Severity Scale (IHSS) is a 14-item, self-reported questionnaire that assesses severity of IH symptoms, including symptoms related to night/inertia (component I) and day/performance (component II). Individual IHSS items measure symptom frequency, intensity, and consequences using 3- or 4-point Likert scales, yielding a total score (range, 0–50), comprising component I (range, 0–16) and component II (range, 0–34). Higher scores indicate worse symptoms. In a recent clinical trial of the efficacy and safety of lower-sodium oxybate (LXB; Xywav™) for the treatment of IH, the IHSS was a key efficacy measure.
Methods: Eligible participants 18–75 years of age with IH began LXB treatment with an open-label treatment titration and optimization period (OLTTOP; 10–14 weeks), followed by a 2-week stable-dose period (SDP). Participants were randomized to placebo or continued LXB treatment during a 2-week, double-blind, randomized withdrawal period (DBRWP). The IHSS was completed at baseline, during OLTTOP (weeks 1, 4, and 8), and at the end of OLTTOP, SDP, and DBRWP. Change in IHSS total score from SDP to DBRWP was a key secondary endpoint.
Results: The efficacy population included 115 participants (mean±SD age, 41±14 years; 71% female). At baseline and the end of SDP, respectively, mean±SD IHSS scores were 31.6±8.3 and 15.3±8.5 for total score, 10.3±3.6 and 5.4±2.8 for component I (night/inertia), and 21.2±5.8 and 9.9±6.5 for component II (day/performance). Worsening from SDP to DBRWP was observed in patients randomized to placebo compared with LXB in IHSS total scores (estimated median difference [95% CI], −12.0 [−15.0, −8.0]; significant P<0.0001), component I scores (LS mean difference [95% CI], −3.9 [−4.9, −2.9]; nominal P<0.0001), and component II scores (LS mean difference [95% CI], −7.8 [−9.6, −5.9]; nominal P<0.0001). Results on all individual IHSS items reflected an improvement with LXB treatment over time during OLTTOP, which remained consistent during SDP.
Conclusion: These results support the efficacy of LXB for the treatment of IH symptoms, as assessed with the IHSS.
Support (if any): Jazz Pharmaceuticals

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DO PATIENTS AND HEALTHCARE PROVIDERS HAVE SIMILAR PERCEPTIONS OF AVAILABLE NARCOLEPSY EDUCATIONAL MATERIALS AND TREATMENT OPTIONS?

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Introduction: Studies have shown that patients typically retain <50% of the information communicated to them by their healthcare providers. This lack of retention can lead to serious problems and misunderstandings regarding the condition, its treatment, and course. The

goal of this study was to compare the information sleep specialists report providing to patients with the materials narcolepsy patients recall receiving.

Methods: Deidentified on-line surveys were submitted to active members of the American Academy of Sleep Medicine and to patients with narcolepsy Type 1 (NT1) and Type 2 (NT2) via the cloud-based software service company SurveyMonkey. These patients were recruited from the private Facebook group 'Doctors and Narcoleptic Patients'.

Results: Results were received from a total of 75 patients (68% NT1, 29% NT2, 3% uncertain type; mean time since diagnosis: 11 years) and 18 sleep specialists (mean time in practice: 22 years). Physicians reported that their practices provided written material about narcolepsy to patients 69% of the time. By contrast, only 32% of patients recall receiving written information. Regarding treatment options, the groups reported variable results, with 94% of doctors/86% of patients discussing modafinil/armodafinil, 89% of providers/68% of patients communicating about amphetamines/methylphenidate, and 83% of physicians/47% of patients considering sodium oxybate. Additionally, only 56% of physicians were aware of narcolepsy patient advocacy organizations.

Conclusion: With the ready availability of social media and the exchange of oft inaccurate medical information, it is essential that physicians supply their patients with accurate up-to-date materials, especially following the diagnosis of a life-altering condition such as narcolepsy. This study suggests that there is a mismatch between the information which physicians believe they are providing and the materials the patients recall receiving. In addition to the medical care sleep specialists provide, patients and their families frequently rely on support from condition-specific organizations. Health care providers should be aware of the local and national organizations and supply their patients with contact information in an effort to provide a more holistic approach to medical care. Efforts are necessary to educate physicians about their patients' needs for on-going care, distinct from that provided solely in the clinical setting.

Support (if any):

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CLINICAL PRESENTATION PRIOR TO IDIOPATHIC HYPERSOMNIA DIAGNOSIS AMONG US ADULTS: A RETROSPECTIVE, REAL-WORLD CLAIMS ANALYSIS

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Introduction: Idiopathic hypersomnia (IH) is a rare, serious central hypersomnolence disorder for which there are no FDA-approved medications available. A retrospective study was conducted to characterize newly diagnosed patients with IH in the United States. Here, we report morbidity and comorbidity claims prior to IH diagnosis.

Methods: Claims from the IBM® MarketScan® database were analyzed between January 2014 and September 2019. The general population cohort included all adults with ≥12 months of continuous enrollment. From this population, a cohort with newly diagnosed IH was identified, defined as ≥2 claims with an IH diagnosis code ≥1 day and ≤180 days apart, and without an IH diagnosis in the 12 months prior to cohort entry. Patients without continuous medical/prescription coverage (enrollment gaps >30 days) in the 12 months prior to cohort entry were excluded. Claims with diagnoses for select morbid/comorbid conditions were identified from 12 months prior to cohort entry for the IH and general population cohorts and summarized using descriptive statistics. A sensitivity analysis was conducted on IH patients with the diagnosis code recorded in the primary position ("primary IH") on the claims to understand the effects of applying a more specific definition of IH.

Results: Of the general population cohort (N=32,948,986; mean age, 42 years; 52% female), 4,980 (0.015%) newly diagnosed IH patients were identified (mean age, 43 years; 67% female). Sleep-related morbidities in the 12 months prior to cohort entry included narcolepsy type 2 (17%/0.1%) and hypersomnia (10%/0.2%) for the IH/general population cohorts, respectively. Common comorbidities were sleep apnea (50%/4%), mood disorders (32%/8%), depressive disorders (31%/7%), anxiety disorders (31%/9%), hyperlipidemia (30%/20%), headache/migraine (24%/7%), diabetes or use of diabetes/obesity medication (20%/12%), hypertension (15%/10%), and cardiovascular disease (14%/8%) for the IH/general population cohorts, respectively. Common morbidities/comorbidities for the primary IH cohort (n=2,205) were generally similar to the overall IH population.

Conclusion: Compared with the general MarketScan® population, morbidities/comorbidities were more common for IH patients across all conditions analyzed, including sleep disorders and psychiatric, cardiometabolic, and cardiovascular disease. With cardiovascular risk factors common upon diagnosis of IH, therapies that do not increase cardiovascular risk are warranted.

Support (if any): Jazz Pharmaceuticals

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IT MAKES RELATIONSHIPS HARDER: THE ROLE OF NARCOLEPSY IN SOCIAL AND ROMANTIC RELATIONSHIPS IN YOUNG ADULTS

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Introduction: Narcolepsy typically begins during adolescence/young adulthood – a crucial period for developing relationships. As symptoms would be expected to impact social interactions, we studied how narcolepsy impacts social, romantic, and sexual relationships in young adults.

Methods: Young adults (18–39 years; N=262) with a self-confirmed narcolepsy diagnosis were recruited through national narcolepsy patient organizations. Participants completed an online survey, including open-ended questions, to evaluate their social, romantic, and sexual relationships and communication with medical providers.

Results: Participants (mean=28.5 years old; SD=5.6) were primarily female (87%), White/Caucasian (92%), employed (75%), and had Narcolepsy Type I (56%). All participants indicated that narcolepsy made social life or entering relationships somewhat or a lot more difficult. Rates of cohabitation and marriage were comparable to nationally representative samples. On the Couples Satisfaction Index, most participants reported feeling satisfied with their romantic relationships (mean=15.8; SD=4.3). On the Multidimensional Scale of Perceived Social Support, participants reported receiving greater support from their significant others (mean=4.5; SD=1.4) compared to both family (mean=3.7; SD=1.5; $p<.05$) and friends (mean=3.9; SD=1.4; $p<.05$). There was no difference between family and friends ($p>.05$). Eighty-percent of participants indicated that narcolepsy impacted their sex life, including experiencing cataplexy or falling asleep during sex. Few participants indicated that their providers asked about their social (31%) and sex life (10%). In contrast, 73% of participants wanted providers to ask about social life and 45% wanted providers to ask about sex life.

Conclusion: Narcolepsy substantially impacts social functioning in young adults. They often prioritize the development of a single,

meaningful romantic relationship as their disorder makes sustaining more social relationships challenging ("I do not go out and socialize at all, but spend all my time at home nurturing my romantic relationship because it's the most important to me"). At a time of sexual development, there are considerable implications of narcolepsy symptoms on their sexual experiences. Though many participants were interested in discussing their social, romantic, and sexual relationships with medical providers, only a small proportion of providers inquire. Effective treatment of narcolepsy in young adults should include support for the impact of the disorder on relationship health.

Support (if any): Jazz Pharmaceuticals.

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UTILIZATION OF DIAGNOSTIC SLEEP TESTING PRIOR TO IDIOPATHIC HYPERSOMNIA DIAGNOSIS AMONG US ADULTS: A REAL-WORLD CLAIMS ANALYSIS

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Introduction: A retrospective analysis was conducted to characterize diagnostic sleep testing during the 12 months before diagnosis of idiopathic hypersomnia (IH), a hypersomnolence disorder with no approved treatments.

Methods: IBM® MarketScan® claims data were analyzed (1/1/14–9/30/19) to identify adults with newly diagnosed IH, defined as ≥2 claims with an IH diagnosis code ≥1 day and ≤180 days apart, and without an IH diagnosis ≤12 months before cohort entry. Demographics, diagnosing physician specialty, and diagnostic sleep disorder testing (identified via claims with procedure codes for multiple sleep latency test/maintenance of wakefulness test [MSLT/MWT], home sleep test, and polysomnography) were summarized. Analyses were performed on patients with IH diagnosis codes recorded in any position on the claims ("overall IH") and in the primary position ("primary IH") to understand the effects of applying a more specific definition of IH.

Results: Of 32,948,986 eligible people, 4,980 (0.015%) newly diagnosed IH patients were identified. Mean age was 43 years and 67% were female; those with primary IH (n=2,205; 44% of overall IH) were younger (mean age, 39 years) and more likely to be female (73%). Long sleep time was documented for 69% of the overall IH group and 67% of the primary IH group. The top 3 diagnosing physicians' specialties were similar for overall IH/primary IH: pulmonology (23%/26%), neurology (14%/16%), and internal medicine (11%/10%). Few patients (9% overall IH; 7% with primary IH) were diagnosed in family practice. Any sleep testing was performed in 44% of overall IH and 53% of primary IH patients. Polysomnography and MSLT/MWT, the most frequently used sleep tests, were less common in overall IH (39% and 22%) than in primary IH (48% and 32%).

Conclusion: IH patients were typically diagnosed by specialists, outside of general medical practice. The most common diagnosing physicians were pulmonologists and neurologists for both the overall and primary IH groups. Objective sleep testing was more frequently documented in diagnosis of primary IH but utilization was low regardless of the definition of IH diagnosis. Further research is needed to investigate the utilization of sleep testing by clinicians for diagnosing IH.

Support (if any): Jazz Pharmaceuticals

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CORRELATION OF THE IDIOPATHIC HYPERSOMNIA SEVERITY SCALE WITH OTHER MEASURES OF SLEEP PARAMETERS IN A PHASE 3 TRIAL

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Introduction: The Idiopathic Hypersomnia Severity Scale (IHSS) is a 14-item, self-reported questionnaire that assesses core Idiopathic Hypersomnia (IH) symptom severity. The relationship between IHSS scores and other IH symptom measures, such as the Epworth Sleepiness Scale (ESS; measures daytime sleepiness), sleep inertia visual analog scale (VAS-SI; measures sleep inertia), and Patient Global Impression of Change (PGIc; measures patients' self-assessed change in symptoms), has not been established. This post hoc analysis analyzed correlations between the IHSS and ESS, VAS-SI, and PGIc using data from a clinical trial (NCT03533114) evaluating lower-sodium oxybate (LXB; Xywav™) for the treatment of IH.

Methods: During a clinical trial, the IHSS (0–50 score range) and ESS (0–24 score range) were completed at baseline; the IHSS, ESS, and PGIc (ordinal, 7 categories) were completed during an open-label treatment titration and optimization period (OLTTOP), after the OLTTOP, after a stable-dose period (SDP), and after a double-blind, randomized withdrawal period (DBRWP). The VAS-SI (0–100 score range) was completed during screening, SDP, and DBRWP. Correlation coefficients (rs) for IHSS vs ESS and VAS-SI were estimated from the within-subject variance matrix using a repeated-measures linear mixed model (LMM). The correlation between changes in IHSS score and PGIc was assessed using a Kruskal-Wallis test.

Results: IHSS scores correlated positively with ESS scores (rs [95% CI], 0.77 [0.73, 0.81]) and VAS-SI scores (0.69 [0.63, 0.75]). IHSS total score change was correlated with PGIc rank (chi-square with 6 degrees of freedom = 595.8, nominal P<0.001). The LMM showed that a 3-point change in ESS score corresponded to an average 3.99-point change in IHSS score; a 10-point change in VAS-SI score corresponded to an average 3-point change in IHSS score. Participants very much improved in the PGIc had a −12.13 (95% CI: −13.23, −11.04) expected change in IHSS score. Participants much improved in the PGIc had a −8.39 (95% CI: −9.30, −7.48) expected change in IHSS score.

Conclusion: IHSS scores or score changes strongly correlated with individual instruments assessing excessive daytime sleepiness, sleep inertia, and self-reported global symptoms, suggesting that the IHSS is a reliable, comprehensive measure of these symptoms of IH.

Support (if any): Jazz Pharmaceuticals

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CLINICAL PK OF XW10172 FOR ONCE NIGHTLY THERAPY IN PATIENTS WITH NARCOLEPSY OR SLEEP DISORDERS IN NEURODEGENERATIVE DISEASES

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Introduction: Patients with narcolepsy and patients with sleep disorders secondary to neurodegenerative diseases have been shown to respond to oxybate. To overcome the limitations of current oxybate therapies, we designed XW10172, a new chemical entity and GABA-B agonist with no sodium or other cation content and for once nightly dosing. The objectives of two clinical studies were to assess the XW10172 pharmacokinetics (PK), pharmacodynamics (PD) and safety/tolerability in normal study participants.

Methods: Two XW10172 studies in healthy participants assessed ascending single and multiple doses, comparison to sodium oxybate in immediate release (IR) and extended release (ER) formulations. PK

parameters were calculated from concentration vs. time data. Safety and tolerability were assessed by monitoring adverse events, laboratory tests, and vital signs.
Results: To date, 84 study participants received XW10172 and the PK from single and multiple dose administration showed doses of 0.1 to 7.25 g had a mean oxybate half-life range of 0.5 to 1.3 hours. Oxybate levels from the drug were about 6-fold higher than XW10172 levels. Oxybate PK from XW10172 (IR) was the same as from equal molar doses of sodium oxybate. XW10172 (ER) formulations showed delayed Tmax with extended oxybate exposure compatible with single nightly dose therapy. PK-PD assessment of somnolence, the desired pharmacologic effect, showed a concentration-effect relationship (Cmax p=0.0004, AUC p<0.0001). XW10172 was generally well tolerated and adverse events were those known to be associated with oxybate.
Conclusion: These data support progression of XW10172 (ER) in further clinical development studies to assess this once nightly GABA-B agonist therapy for the treatment of patients with various sleep disorders.
Support (if any): XWPharma

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IDIOPATHIC HYPERSOMNIA AND CO-OCCURRING PSYCHOPATHOLOGY AMONG VETERANS
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Introduction: Idiopathic hypersomnia (IH) is relatively rare and characterized by excessive daytime sleepiness despite prolonged and undisturbed sleep as well as the absence of cataplexy and other causes of hypersomnolence. The etiology of IH is largely unknown. The present study capitalized on electronic medical record (EMR) data from the Veterans Health Administration (VHA) to create a cohort of veterans diagnosed with IH in order to: 1) estimate the prevalence of IH diagnosis in the VHA, and 2) identify co-occurring physical and behavioral health conditions to characterize IH in the sample.
Methods: Using 2009–19 VHA EMR data, we created two cohorts: those with an IH diagnosis (N = 3,674) or a hypersomnia diagnosis (e.g., primary hypersomnia) other than IH (N = 110,530). Diagnostic data (i.e., ICD 9 and 10 codes) were extracted for the 6-months prior to index diagnosis to examine group differences in the prevalence of physical and behavioral health conditions.
Results: Veterans diagnosed with IH, as compared to veterans with another hypersomnia disorder, were more likely to be female (30.1% vs 12.3%) and less likely to be obese (16% vs 28.3%; chi-squared = 79.27, p <.001), or carry diagnoses of diabetes (type 1 or 2; 9.7% vs 24.4%; chi-squared = 123.02, p <.001), or anxiety disorders (5.8% vs 9.5%; chi-squared = 16.83, p <.001). Individuals with IH were more likely to carry diagnoses of chronic fatigue syndrome (4.2% vs 1.6%; chi-squared = 45.91, p <.001), depression (31.3% vs 23.4%; chi-squared = 36.04, p <.001), and posttraumatic stress disorder (29.5% vs 26.5%; chi-squared = 5.79, p = .02).
Conclusion: Data suggest that veterans diagnosed with idiopathic hypersomnia may present with different diagnostic profiles than veterans with other hypersomnia disorders. Far more basic and clinical research is needed in IH.
Support (if any): This work was supported by the Hypersomnia Foundation and in part by the VA Center of Excellence for Suicide Prevention in the Finger Lakes Healthcare System.

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CARDIO-VASCULAR BURDEN OF NARCOLEPSY DISEASE (CV-BOND): A REAL-WORLD EVIDENCE STUDY
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Introduction: Narcolepsy is a rare, lifelong disorder that requires long-term treatment and is associated with multiple comorbidities, including cardiovascular conditions. Many available treatments have cardiovascular-related warnings and precautions in their labels. The objective of this study was to estimate the incidence of cardiovascular comorbidities in adult patients with a narcolepsy diagnosis in the US.
Methods: Claims from IBM® MarketScan®, an administrative claims database, between January 2014 and June 2019 were analyzed. Eligible patients were ≥18 years and had continuous medical and prescription coverage (gaps <30 days allowed). The narcolepsy cohort was defined by ≥2 outpatient claims containing a diagnosis of narcolepsy type 1 or type 2 on separate days and no more than 6 months apart, with ≥1 non-diagnostic office-visit. Non-narcolepsy patients were matched 3:1 to narcolepsy patients by calendar date of cohort entry, age, gender, US geographic region, and insurance type. Each incidence calculation required a 6 month wash-out period prior to cohort entry. Differences between cohorts were evaluated using a Cox proportional hazard model adjusted for age, gender, region, insurance type, and relevant morbidities/comorbidities and medications in the baseline period.
Results: Of 54,239,110 adults in the database, 12,816 and 38,441 were included in the narcolepsy and matched non-narcolepsy cohort. Approximately 67% were female patients and mean age was approximately 38 years in both cohorts. Incidence rates (per 1,000 person-years) for newly recorded cardiovascular comorbidities or events in narcolepsy/non-narcolepsy were: CVD without hypertension (13.29/7.99), MACE+ (11.75/6.86), heart failure (5.72/3.41), stroke (4.28/2.17), ischemic stroke (3.69/1.91), edema (9.84/4.22), and a composite of stroke, atrial fibrillation, and edema (17.73/8.88).
Conclusion: Physicians should consider the increased cardiovascular risk when considering risk modification strategies and treatment options for narcolepsy patients. Further research is needed to understand treatment-specific risks.
Support (if any): Jazz Pharmaceuticals

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ASSESSMENT OF THE CLINICAL BENEFITS OF PITOLISANT ON EXCESSIVE DAYTIME SLEEPINESS AND CATAPLEXY IN ADULTS WITH NARCOLEPSY
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Introduction: When evaluating results of randomized, placebo-controlled trials, the clinical impact of a treatment can be assessed using number needed to treat (NNT; number of patients that need to be treated to achieve a specific outcome for one person) and effect size (magnitude of drug–placebo difference on outcome measures). Lower NNTs indicate a more robust effect; NNT <10 is generally considered to represent a meaningful between-treatment difference. This analysis evaluated NNTs and effect sizes for pitolisant in the treatment of excessive daytime sleepiness (EDS) and cataplexy, using data from 7- or 8-week, randomized, placebo-controlled studies.
Methods: Patients in both studies experienced EDS at study baseline (Epworth Sleepiness Scale [ESS] score ≥14 in HARMONY-1 and ≥12 in HARMONY-CTP); patients in HARMONY-CTP also experienced ≥3 cataplexy attacks/week. Pitolisant was titrated over a 3-week period to a maximum potential dose of 35.6 mg/day, after which the dose remained stable. End-of-treatment assessments occurred at Week 8 in HARMONY-1 and Week 7 in HARMONY-CTP. Treatment response

was defined for EDS based on ESS score reduction (≥3-point decrease from baseline or final score ≤10) and for cataplexy as ≥50% reduction from baseline to stable-dose period in the weekly rate of cataplexy (WRC). NNTs were calculated as the inverse of the drug–placebo difference in response rates. Effect sizes for change from baseline in mean ESS score and WRC were calculated using Cohens' d. Missing values were imputed using a last-observation-carried-forward approach.
Results: Treatment response for EDS was observed in HARMONY-1 (pitolisant, n=31; placebo, n=30) in 67.7% of pitolisant-treated versus 43.3% of placebo-treated patients (NNT=5) and in HARMONY-CTP (pitolisant, n=54, placebo, n=51) in 68.6% versus 34.0% of patients, respectively (NNT=3). In HARMONY-CTP, treatment response for cataplexy was observed in 66.7% of pitolisant-treated patients versus 25.5% of placebo-treated patients (NNT=3). Effect sizes were 0.61 (HARMONY-1) and 0.86 (HARMONY-CTP) based on ESS change scores, and 0.86 (HARMONY-CTP) based on change in WRC.
Conclusion: The low NNTs and large effect sizes observed in this analysis provide further evidence that pitolisant produces meaningful clinical benefits in the treatment of EDS and cataplexy in adults with narcolepsy.
Support (if any): Bioprojet Pharma and Harmony Biosciences, LLC.

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EFFICACY OF PITOLISANT IN THE TREATMENT OF CATAPLEXY IN ADULTS WITH NARCOLEPSY

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Introduction: Pitolisant was initially approved by the FDA in 2019 for the treatment of excessive daytime sleepiness in adult patients with narcolepsy; in 2020, the indication was expanded to include the treatment of cataplexy.
Methods: Cataplexy data from 7- or 8-week, randomized, placebo-controlled studies (HARMONY-CTP, HARMONY-1) are reviewed and summarized. In HARMONY-CTP, all patients were required to have ≥3 cataplexy attacks per week at baseline; HARMONY-1 enrolled patients with narcolepsy with or without cataplexy. Pitolisant was individually titrated to a maximum potential dose of 35.6 mg/day. The weekly (WRC) or daily (DRC) rate of cataplexy attacks was calculated from patient diaries.
Results: In HARMONY-CTP (pitolisant, n=54; placebo, n=51), mean baseline WRC was 11.7 in the pitolisant group and 9.6 in the placebo group. In the subset of HARMONY-1 patients with cataplexy (pitolisant, n=17; placebo, n=11), mean baseline DRC was 1.5 and 1.2, respectively. In HARMONY-CTP, least-squares (LS) mean change in WRC was significantly greater for pitolisant versus placebo at Week 2 (-4.1 vs 1.2; P=0.004) and continued through end of treatment (Week 7; -6.5 vs -0.1; P<0.001). In HARMONY-CTP, treatment response was observed in 66.7% of pitolisant-treated versus 25.5% of placebo-treated patients (P<0.001) for WRC reduction ≥50%, and 77.8% versus 33.3% of patients (P<0.001) for WRC reduction ≥25%. In HARMONY-1, LS mean change in DRC was significantly greater for pitolisant versus placebo at Week 5 (-1.04 vs 0.17; P=0.047) and continued through end of treatment (Week 8; -0.96 vs 0.35; P=0.035). In a pooled analysis of patients with high burden of cataplexy (≥15 attacks/week) at baseline (pitolisant, n=20; placebo, n=11), LS mean change in WRC at end-of-treatment assessment was significantly greater for pitolisant (-14.5; baseline, 23.9; final, 9.4) versus placebo (-0.1; baseline, 23.1; final, 23.0; P=0.004). There was no evidence of rebound cataplexy after a 1-week placebo washout period.
Conclusion: Pitolisant, at once-daily doses of up to 35.6 mg, demonstrated a statistically significant and clinically meaningful reduction in the frequency of cataplexy attacks in adults with narcolepsy, including patients with a high symptom burden. Onset of response was observed within the first few weeks of pitolisant treatment.
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SAMELISANT: BASELINE CHARACTERISTICS FROM A PHASE 2 STUDY EVALUATING EFFICACY AND SAFETY IN PATIENTS WITH NARCOLEPSY

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Introduction: histamine H3 receptor (H3R) antagonists/ inverse agonists increase histaminergic neurotransmission and offer a therapeutic option for the treatment of narcolepsy. Samelisant (SUVN-G3031) is a potent and selective H3R inverse agonist exhibited selectivity over 70 other targets. Samelisant showed wake-promoting and anticataplectic effects in orexin knockout mice suggesting its potential therapeutic utility in the treatment of EDS and cataplexy associated with narcolepsy. Safety and tolerability studies in animals and healthy humans suggested a favorable risk/benefit profile.
Methods: The current study is a 2 week treatment, multicenter, double-blind, placebo controlled, parallel-group study in patients with Narcolepsy with or without Cataplexy. Eligibility criteria include age between 18 to 50 years old, an ESS score of ≥ 12; and mean MWT time of < 12 minutes and a confirm diagnosis of narcolepsy as per ICSD-3. Further, the randomization will be stratified according to type of narcolepsy (Type-1 or Type-2). Each subject will receive either placebo or study drug once daily for 2 weeks in a fixed ratio of 1:1:1. The primary efficacy endpoint is change in maintenance of wakefulness test (MWT) score from baseline to week 2. Key secondary endpoints include change from baseline to week 2 in ESS and an improvement in CGI-S scores. Safety will be monitored by medical monitor and by an independent data safety monitoring committee. Baseline clinical and demographic data for the currently enrolled study is summarized descriptively. Since the study is blinded, a breakdown of baseline characteristics by treatment group will not be available until after completion.
Results: As of data cutoff date of Dec 20, 2020, a total of 54 subjects were completed in the study. The median age of subjects was 30 years (range: 18 - 50 years) with mean BMI of 28.6 (range: 18.3 - 43.1 kg/m2). Overall, 74% of subjects were female and 83% were Caucasian. Mean (SD) baseline values of MWT and ESS are 5.65 (3.5) and 16.7 (2.5), respectively.
Conclusion: Baseline characteristics are consistent with the general narcolepsy population. The study is currently enrolling the subjects with Narcolepsy with or without Cataplexy, and the Data readout is expected in the second half of 2021.
Support (if any):

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CLINICAL IMPRESSION OF EXCESSIVE DAYTIME SLEEPINESS (EDS) AT INITIAL SLEEP MEDICINE (SM) CONSULTATION AND ITS CLINICAL CORRELATES

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Introduction: EDS represents a cardinal symptom in SM. Use of subjective scales are prevalent, which have a modest correlation with the MSLT. While the Clinical Global Impression has been used in research, reports of clinical impression (CI) in medical practice are lacking. We report on the CI of EDS in a convenience sample of patients undergoing initial consultation.
Methods: Patients reported primary, secondary symptoms and completed the Sleep Wake Activity Inventory (SWAI) prior to Tele-Medicine consultation. A SM physician completed the assessment which included ascertainment of CI of EDS (presence S+ / absence S-).
Results: There were 39 ♂and 13 ♀. The CI identified 26 patients in each group (S+/S-). Age (52 [14]), BMI (33 [7]), reported time in bed, sleep time, sleep onset latency and # of awakenings did not differ. All identified a primary symptom (S-: 21, S+: 19 reported snoring or a previous Dx of OSA). Sleepiness as a 1ry or 2ry symptom was identified by 0 in the S- and by 13 in the S+ groups. Refreshing quality of sleep differed ($\chi 2$ <0.05): un-refreshing sleep was reported by 7 (S-) and by 13 (S+). Naps/week: 0.7 [1.5] and 1.57 [1.5] for the S-, S+ groups respectively ($p<0.05$). A main effect ($p<0.01$) was documented on the SWAI. We report on the Sleepiness [SS] and Energy Level [EL] scales (lower scores on the SS reflect higher sleepiness while lower scores on EL denote higher energy). Higher sleepiness ($p<0.01$) 43 [12] and lower energy levels 24 [6] ($p<0.05$) were documented on the S+ group (S- 61 [17], and 18 [6] respectively). Available spouse's Epworth score on 29 patients: S- patients 5.8 [4] and S+ 10.2 [6] ($p<0.05$). Dx of OSA was identified among all but 1 in the S+ group. Also, Insomnia was diagnosed among 11 (S-) and 19 (S+) patients ($p<0.05$) despite only 3 and 7 (respectively) identifying it as a presenting symptom.
Conclusion: While snoring or previous Dx of OSA were prevalent motivations for consultation, sleepiness and insomnia were clinically relevant among a substantial number of patients. Unrefreshing sleep, daytime naps, lower energy, and higher sleepiness were ubiquitous among S+ patients.
Support (if any):

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NARCOLEPSY ASSOCIATED WITH A HISTORY OF HEAD INJURY: A RETROSPECTIVE REVIEW

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Introduction: Head injuries are becoming much more prevalent and may be secondary to sports injuries, motor vehicle accidents, falls, domestic violence, assault, and military blast explosions. Sleepiness may occur acutely and/or chronically after a head injury. Chronic hypersomnia may be overlooked or under-reported in those with a history of head injury, and the association may not be made. Hypersomnia can occur in those with mild, moderate, and severe head injuries, with or without loss of consciousness. The pathophysiology/neuropathology of sleep-wake disturbances after Traumatic Brain Injury was discussed by Lim and Baumann 2020 in their Up To Date review entitled "Sleep-wake disorders in patients with traumatic brain injury". They reported possible abnormalities in orexin/hypocretin, decreased histaminergic neurons, melatonin abnormalities, decreased serotonergic neurons, decreased noradrenergic neurons, and structural brain changes that can play a role. It is also possible that a head injury occurs in someone predisposed to the development of narcolepsy or that the sleepiness of undiagnosed narcolepsy leads to increased injuries.
Methods: A retrospective review of charts from 2013 to 2020 revealed 176 patients diagnosed with narcolepsy in our psychiatric/sleep outpatient practice. Information on head injuries was obtained by questionnaires completed by the patient and/or interview with staff. Narcolepsy was diagnosed by PSG/MSLT and/or DSM-V criteria of narcolepsy.
Results: Of the 176 patients diagnosed with narcolepsy, 125 were female (71%) and 51 were male (29%). The age range was 11 to 75 years, with an average age of 39 years old. Cataplexy was present in 117 patients (66.8%). A history of a head injury was reported at intake by 50 patients (28.4%). Of the patients with a history of a head injury, 34 (68%) were female, 16 (32%) were male, and 36 (72 %) had a history of cataplexy.
Conclusion: This study revealed 28.4% of patients diagnosed with narcolepsy reported a history of a head injury of varying degrees of severity. While direct causation cannot be declared, the association of a head injury and continued hypersomnia suggests further evaluation of narcolepsy may be beneficial.
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HEALTH-RELATED QUALITY OF LIFE IN NARCOLEPSY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Narcolepsy is a neurological condition that has been associated with considerable detriment to daily life including impaired quality of life, occupational and academic difficulties and adversely affected social and personal relationships. To date, there has been no systematic analysis of the literature regarding health-related quality of life (HRQoL) in Narcolepsy. This systematic review aimed to examine the impact of narcolepsy on HRQoL, measured through standardised HRQoL questionnaires such as the Short Form 36 (SF36).
Methods: Medline, Embase, Cinahl and Web of Science were searched for studies which investigated HRQoL in adults with narcolepsy. Studies were reviewed independently by two reviewers, and a random-effects meta-analysis was performed. The methodological quality of the included studies was assessed using a modified version of the Joanna Briggs Institute Checklist for Analytical Cross Sectional Studies tool. The impact of study variables and characteristics on HRQoL was assessed using Spearman's Correlation analyses with adjusted r2 values.
Results: A total of 30 studies were eligible for inclusion in the review. Additionally, meta-analyses were conducted for the SF36 and the EQ5D. The SF36 meta-analysis identified that the pooled mean scores for the Physical Component Summary (45.91) were less affected than the Mental Component Summary (42.98). The HRQoL of people with narcolepsy was compared to general population norms (US, UK, France and Norway) and to people with chronic diseases including multiple sclerosis, diabetes, and epilepsy.
Conclusion: People with narcolepsy report significant impairments in HRQoL when compared to the general population and other chronic health conditions including epilepsy, multiple sclerosis, diabetes and hypertension, especially concerning their mental wellbeing. Further research is warranted to identify the longitudinal effects of narcolepsy on HRQoL and to develop a narcolepsy-specific HRQoL tool.
Support (if any): This review was completed as part of Mr Ragy Tadrous' Master of Science (MSc) degree in Trinity College Dublin. This degree was co-sponsored by the Physiotherapy Department in St. James's Hospital, Dublin.

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A PROFILE OF PHYSICAL PERFORMANCE VARIABLES IN AN OUT-PATIENT ADULT POPULATION WITH NARCOLEPSY

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Introduction: Narcolepsy can significantly impact the physical and mental wellbeing of people with narcolepsy, and has been associated with significant reductions in quality of life and physical performance. People with narcolepsy demonstrate many barriers to being physically fit and active, such as sleepiness and social isolation. Despite physical functioning and vitality being the most affected domains of health-related quality of life in this cohort, little is known about how physical performance variables are affected in people with narcolepsy.
Methods: This cross-sectional study profiled the physical performance of adults with narcolepsy attending the Narcolepsy Centre located in St. James's Hospital. Participants underwent a physical performance test battery that investigated cardiopulmonary fitness, physical activity, muscle strength and endurance. Furthermore, health-related quality of life (HRQoL), symptom severity and sedentary behaviour was ascertained through self-report questionnaires.
Results: A total of 23 participants were recruited in this study. The majority of participants were female (n=13, 56.52%) and the mean age was 31.53 (± 13.17) years. Physical performance was generally found to be lower than age-and-gender matched normative values for cardiopulmonary fitness, physical activity and muscle strength and endurance. Participants' completed 42.20 ± 21.41 minutes of moderate-vigorous physical activity daily as measured by actigraphy. Considerable sedentary behaviour was objectively measured in this sample (10.21 hours). Symptom severity was high as measured by the Epworth Sleepiness Scale and the Narcolepsy Severity Scale, and participants reported reduced quality of life when compared to general population norms (US, UK, France and Norway).
Conclusion: Markedly reduced physical performance was identified in this sample of people with narcolepsy, irrespective of participant age, gender and BMI. Future research should explore the role of exercise in improving the physical fitness in people with narcolepsy, and the influence of exercise on HRQoL and symptom severity in this cohort.
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PATHOLOGICAL SLEEP PROLONGATION AND SLEEP ONSET REM PERIOD

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Introduction: ICSD-3 employs two definitions of pathological sleepiness: sleep prolongation with 24-hour total sleep time (24hrPSG TST) ≥660 and high sleep propensity with mean sleep latency(mSL) ≤8 min on MSLT. Multiple SOREMPs on MSLT reflects the pathophysiology (sleep instability) of narcolepsy, but it is not clear whether the lack of SOREMPs is associated with the pathophysiology of idiopathic hypersomnia. We performed 24hr PSG and PSG-MSLT sequentially to understand the meaning of SOREMP in those with pathological sleep prolongation.
Methods: Fifty-six consecutive patients visiting Seiwa Hospital or Koishikawa Tokyo Hospital affiliated to Institute of Neuropsychiatry with suspected idiopathic hypersomnia with habitually long sleep time were evaluated by 3-day sleep studies: unattended 24hr PSG followed by PSG and MSLT from January 2017 to November 2020. After excluding inadequate recordings or other sleep pathologies, we analyzed 52 data and found that 39 patients (23 females, 21.8 ± 7.9 years old, BMI 20.4 ± 2.5 kg/m2) exhibited pathological sleep prolongation.
Results: We divided 39 patients with pathological sleep prolongation into those with at least one SOREMP(n=9) and those without SOREMP(n=30) and explored differences in clinical symptoms and PSG variables. There were no differences in conventional sleep variables except for PSG sleep latency, shorter in those with SOREMP (20.8min vs 43.8min, p=0.032). Also 24hr PSG sleep variables showed no differences except for the number of NREM-REM cycles, more in those with SOREMP (10.4 vs 8.1, p=0.037). Frequency of clinical symptoms such as REM related phenomena and various symptoms characteristic for idiopathic hypersomnia did not differ between groups except for less frequency of general malaise p=0.003 and orthostatic hypotension p=0.049 in those with SOREMP. We had similar results when we compared 5 patients with multiple SOREMPs and 30 patients without SOREMP.
Conclusion: Our results indicated that sleep variables and clinical characteristics of idiopathic hypersomnia in those with pathological sleep prolongation were mostly the same regardless of the status of SOREMP on MSLT, suggesting that the absence of SOREMPs on MSLT were not fundamentally related to the pathophysiology of those with pathological sleep prolongation (idiopathic hypersomnia with long sleep time).
Support (if any):

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CONFIRMATORY FACTOR ANALYSIS OF THE SLEEP INERTIA QUESTIONNAIRE IN A CLINICAL SAMPLE WITH SLEEP DISORDERS

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Introduction: The Sleep Inertia Questionnaire (SIQ) was developed and validated in patients with mood disorders to evaluate difficulties with becoming fully awake after nighttime sleep or daytime naps in a multidimensional manner. However, few data are available regarding its psychometric properties in clinical samples with sleep disorders.
Methods: 211 patients (43.0±16.4 years old, 68% female, 17% minority) evaluated at the Behavioral Sleep Medicine (BSM) program of Penn State Health Sleep Research & Treatment Center completed the SIQ. All patients were diagnosed using ICSD-3 criteria, with 111 receiving a diagnosis of chronic insomnia disorder (CID), 48 of a central disorder of hypersomnolence (CDH), and 52 of other sleep disorders (OSD). Structural equation modelling was used to conduct confirmatory factor analysis (CFA) of the SIQ.
Results: CFA supported four SIQ dimensions of "physiological", "cognitive", "emotional" and "response to" (RSI) sleep inertia with adequate goodness-of-fit (TLI=0.90, CFI=0.91, GFI=0.85, RMSEA=0.08). Internal consistency was high (α=0.94), including that of its dimensions (physiological α=0.89, cognitive α=0.94, emotional α=0.67, RSI α=0.78). Dimension inter-correlations were moderate to high (r=0.42–0.93, p<0.01), indicating good construct validity. Convergent validity showed moderate correlations with Epworth sleepiness scale (ESS) scores (r=0.38) and large correlations with

Flinders fatigue scale (FFS) scores (r=0.65). Criterion validity showed significantly (p<0.01) higher scores in subjects with CDH (69.0±16.6) as compared to those with CID (54.4±18.3) or OSD (58.5±20.0). A SIQ cut-off score ≥57.5 provided a sensitivity/specificity of 0.77/0.65, while a cut-off score ≥61.5 provided a sensitivity/specificity of 0.71/0.70 to identify CDH vs. ESS<10 (AUC=0.76).
Conclusion: The SIQ shows satisfactory indices of reliability and construct validity in a clinically-diverse sleep disorders sample. Its criterion validity is supported by its divergent association with hypersomnia vs. insomnia disorders, as well as its adequate sensitivity/specificity to identify patients with CDH. The SIQ can help clinicians easily assess the complex dimensionality of sleep inertia and target behavioral sleep treatments. Future studies should confirm the best SIQ cut-off score by including good sleeping controls, while clinical studies should determine its minimal clinically important difference after pharmacological or behavioral treatments.
Support (if any):

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YOUNG PATIENTS WITH HYPERSOMNIA AT TUFTS MEDICAL CENTER

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Introduction: Young people with hypersomnia (up to 30 years old) represent unique clinical patients that are relatively unstudied. This population has complex presentations, may have increased utilization of medical resources, and have additional and or untreated comorbid conditions such as mild OSA (Obstructive Sleep Apnea). This project looks to characterize and inventory clinical variables of this subset of sleep medicine patients at Tufts Medical Center. In addition, we seek to tabulate management of these patients in order to specifically delineate whether or not treating mild OSA in this group resulted in clinical improvement.
Methods: After IRB approval, a retrospective database was used to search for patients up to age 30 with comorbid hypersomnia diagnoses from 5/1/2015 to 12/2020. De-indentified datasets, including multiple clinical variables and demographics were analyzed and compared to an age-matched control group of patients who also included an OSA diagnosis.
Results: Various clinical and demographic data sets were collected in the hypersomnia patient population to characterize the quality and nature of their sleep and hospital utilization. Our preliminary results for this sub-population of 96 patients have found that on average these patients had 2.16 visits to our medical center with some outliers with as many as 6–10 visits in a two-year period from the initial contact. This group had a mean WASO (Wake After Sleep Onset) of 48.95 minutes, a mean sleep latency of 8.56 minutes, and a mean amount of stage N1 sleep of 25.6 minutes (6.4%). Further research will be done to compare these values and more to a similar population with OSA.
Conclusion: Our retrospective review identifies clinically important data relevant to the sleep quality, patient management, and resource utilization of young patients with hypersomnia. Further research with a comparison to a control group with OSA may identify important differences or nuances between these groups.
Support (if any): None

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NARCOCATAPLECTIC PATIENTS, PSYCHIATRIC SYMPTOMS AND EXECUTIVE FUNCTIONS: IS THERE A LINK?

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Introduction: Narcolepsy with cataplexy (NC) is a neurological disorder characterized by orexin deficiency in the hypothalamus with associations to areas implied in emotion. Several studies highlighted a deficit in executive functions in narcoleptic patients. Moreover literature reports a wide comorbidity between NC and psychiatric disorders, but the relationships in NC patients are still unclear. The aim of our study is to evaluate possible mood and anxiety disorders in NC patients and understand their relationship with cognitive performances.
Methods: We assessed 15 NC patients with questionnaires concerning degree of somnolence [ESS], depression [BDI-II], perceived stress [PSS], state and trait anxiety [STAY-Y I and II]. Furthermore, patients performed a battery test (PEBL - psychology experiment building language) to investigate executive functions through 7 tests (Berg's Card Sorting Test [BCST]; Tower of London [TOL]; Continuous Performance Task [CPT]; Go / No-go Task; Victoria Stroop Test [VST]; Balloon Analogue Risk Task [BART]; Digit Span Forward).
Results: Descriptive analyses show that NC subjects have pathological daytime sleepiness (16,07±2,94), moderate perceived stress (19,73±3,95), mild state anxiety (48,67±15,77). However, subjects do not show pathological indexes in depression and in trait anxiety. We also found a positive correlation in both state and trait anxiety with failure to maintain set in the BCST test (r=0,644; p=0,010 and r=0,573; p=0,025, respectively). However, no significant correlations were found between PEBL scores and excessive daytime sleepiness, depression, and perceived stress.
Conclusion: Our data confirm that NC subjects show symptoms related to stress and anxiety, that can facilitate the change of the set during cognitive performances. Since the neurotransmission of hypocretin is involved in the regulation of stress and anxiety, it is important to understand whether these symptoms are primary pathological phenomena in NC patients. Our data suggest that sleep medicine experts should also consider psychiatric aspects during the cognitive assessment of NC patients.
Support (if any): None

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EXCESSIVE DAYTIME SLEEPINESS: BEYOND THE EPWORTH SLEEPINESS SCALE RESULTS FROM A POPULATION-BASED STUDY

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Introduction: Excessive daytime sleepiness (EDS) is a common symptom present in several clinical, mental and sleep disorders. However, its subjective metrics have been criticized in the literature due to lack of association with disorder severity, or disagreement with

objective measures. Epworth Sleepiness Scale (ESS) is a widely used questionnaire to evaluate EDS, however it may not be sufficient as a sole measure to identify cases of somnolence in the general population. Study objectives: To investigate the association between EDS with socio-demographic, body composition and PSG measures in the general population of São Paulo, Brazil.
Methods: 1,042 participants from a population-based epidemiological study underwent full in-lab PSG, questionnaires (ESS, fatigue, quality of life, depression and anxiety scales), bio impedance, socio-demographic and anthropometric measures at baseline and in the follow-up 9 years later. A univariate linear regression analysis including the whole sample (baseline and follow-up) was performed to analyze predictors of EDS and ESS score in the follow-up was the dependent variable. All variables with a p-value <0.15 were included in an exploratory factor analysis (principal component analysis with Varimax rotation) to assess the factorial structure of EDS.
Results: The results supported a five-factorial structure associated with EDS as follows: Factor 1 - Quality of life (Physical and Psychological domains of WHOQOL), Factor 2 – Fatigue (questions from Chalder Fatigue Scale concerning weakness, tiredness, lack of energy and less strength in the muscles), Factor 3 – PSG – sleep duration (wake after sleep onset, sleep efficiency, total time spent awake), Factor 4 – PSG – sleep structure (arousal index, N1 and N3 duration), Factor 5 – Body composition (body mass index). PSG variables related to sleep disordered breathing and movement disorders were not associated with EDS.
Conclusion: EDS measured by ESS was associated with domains other than sleep disorders in the general population. ESS metrics was significantly associated with fatigue and sleep duration.
Support (if any): Associação Fundo Incentivo à Pesquisa (AFIP), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES – Processo 88887.468428/2019-00).

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IMPACTS OF CHRONIC NAUSEA AND VOMITING ON DAYTIME SLEEPINESS AND FATIGUE

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Introduction: Chronic nausea and vomiting (CNV), common symptoms in patients with GI disorders like gastroparesis, can be a debilitating health problem with considerable impact on patients' health-related quality of life during daytime. Yet, little is known about how CNV may impact on sleepiness and fatigue during the daytime. Our aim was to examine the impact of CNV on daytime sleepiness and fatigue based on the data from a longitudinal study.
Methods: Prospective longitudinal study with two waves: 12,218 subjects interviewed by phone during wave 1 (W1); 10,931 during wave 2 (W2) three years later. The sample was representative of the US general population. Analyses included subjects participating to both waves (N=10,931). CNV was defined as episodes of nausea and vomiting occurring at least twice a month for at least 1 month (outside pregnancy). Logistic regression models were employed to determine whether CNV is a predictive variable for excessive sleepiness or fatigue.
Results: Out of all W1 participants, 9.8% (95% CI: 9.2%-10.4%) reported nausea only while 3% (95% CI: 2.7%-3.3%) reported CNV. In W2, 7.7% (95% CI: 7.2%-8.2%) reported nausea only and 2.5% (95% CI: 2.2%-2.8%) reported having CNV. Of the subjects who participated in both W1 and W2, 25.7% of them reported CNV in W1. CNV subjects reported more frequently excessive daytime sleepiness (53.5% vs. 25.9%) and being moderately or severely fatigued (38.6% vs, 5.4%) compared with the participants without nausea or vomiting. After controlling for age, sex, BMI, health status, alcohol intake, sleep disorders and psychiatric disorders that might impact on daytime sleepiness or fatigue, it was found that subjects with CNV at both W1 and W2 had a significantly higher relative risk of reporting daytime sleepiness (RR: 2.7 (95% CI:1.9–3.9) p<0.0001) and fatigue (RR: 4.9 (95% CI:3.2–7.5) p<0.0001) at W2, compared with the participants without nausea or vomiting.
Conclusion: Many factors are likely to influence daytime sleepiness. CNV appears to be an important contributor even after controlling for several factors that can explain the sleepiness. This underlines the extent to which alertness could be disturbed and impacted by chronicity of nausea/vomiting symptoms.
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FACTORIAL STRUCTURE OF HYPERSOMNOLENCE AS MEASURED BY THE EPWORTH SLEEPINESS SCALE

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Introduction: Hypersomnolence, or excessive sleepiness, is highly prevalent in the general population. It can be a cause or a consequence of several sleep, psychiatric disorders or physical diseases. However, self-report tools to assess hypersomnolence are relatively limited; apart the Epworth Sleepiness Scale (ESS), there is little choice to measure hypersomnolence. Our aim is to examine the association between hypersomnolence with health, psychiatric disorders and sleep in the general population
Methods: The initial study was carried with 15,929 individuals from 15 US States. The longitudinal study was carried on in eight of these states. A total of 12,218 subjects were interviewed by phone during the first wave (W1) and 10,930 at the second wave (W2) three years apart. The analyses were carried on the subjects who participated in both interviews (N=10,930). A univariate linear regression analysis including the whole sample (baseline and follow-up) was performed to analyze predictors of hypersomnolence and ESS score in the follow-up was the dependent variable. All variables with a p-value <0.15 were included in an exploratory factor analysis (principal component analysis with Varimax rotation) to assess the factorial structure of hypersomnolence.
Results: Our results support a three-factor structure associated with hypersomnolence. The first factor explained 24.9% of the variance and grouped together presence of medical conditions, psychiatric disorders, body mass index and sleep-disordered breathing. The second factor explained 12.9% of the variance and grouped together napping, fatigue (as measured the Fatigue Severity Scale) and poor quality of life. Finally, the third factor grouped together disrupted sleep and sleep duration and explained 11.7% of the variance.
Conclusion: Hypersomnolence as measured by the ESS is associated with pathologies unrelated to sleep disorders in the general population. The first factor is mostly related to health factors while the second factor might be related to hypersomnia and the third factor to insomnia.
Support (if any):

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PRELIMINARY REPORT ON THE EFFICACY OF BEHAVIORAL THERAPY FOR INSOMNIA IN SHIFT WORK DISORDER: A RANDOMIZED CONTROL TRIAL

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Introduction: Around 33% of shift workers suffer from shift work disorder (SWD). SWD includes insomnia and sleepiness related to the atypical work schedule. Most SWD treatments rely on light therapy or pharmacology. Few studies explored CBT-I efficacy for insomnia in shift work and reported promising results. The study aims to evaluate the efficacity of a behavioral therapy for insomnia adapted for SWD (BT-SWD).

Methods: Forty-three night shift workers meeting SWD criteria were recruited (mean age = 34 years old; 77% women) and randomized to either BT-SWD or waiting list control group. Eight participants dropped-out while waiting. Before and after treatment, participants completed questionnaires (ESS, ISI, STAI and BDI-II) and sleep diaries throughout the experimentation. BT-SWD involves sleep restriction therapy and stimulus control for insomnia as well as fixed sleep periods in the dark for shift workers. BT-SWD has been applied to night sleep, day sleep, and naps in this order. It consists of 6 sessions of 50 minutes delivered on 8 weeks. A mixed MANOVA was conducted on questionnaires scores with group (treatment or waitlist) as the between-subject factor and time as the within subject factor.

Results: A multivariate interaction effect was significant, $F(6,21) = 8.24$, $p<.001$. A univariate interaction effect was observed for the BDI-II ($p=.042$), the trait scale of the STAI ($p=.021$) and the ISI, both for night sleep ($p=.027$) and day sleep ($p<.001$), indicating that the scores of participants in the treatement group lowered significantly more than those of participants on the waiting group. The treatment group had a significantly less severe insomnia, both for day sleep during night work ($p<.001$), and night sleep during days off ($p<.001$). There was no significant difference between the control and the treatment group on sleepiness levels.

Conclusion: BT-SWD is effective at reducing insomnia severity as well as levels of trait anxiety and depression. Results are more equivocal for sleepiness. The waiting list control group design used has led to an important attrition in the context of shift work. Further analyses are needed to determine the BT-SWD efficacy on sleep variables.

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RESTLESS LEGS AND PERIODIC LIMB MOVEMENTS IN 86 PATIENTS WITH MULTIPLE SCLEROSIS

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Introduction: The aim of this study was to assess the prevalence of restless legs syndrome (RLS), periodic limb movements during sleep (PLMS) and their overlap in a large population of patients with multiple sclerosis (MS), and to compare clinical and paraclinical findings between patients with and without RLS/PLMS.
Methods: In this cross–sectional, observational, instrumental study, eighty-six patients (M/F: 27/59; mean age 48.0 ± 10.8 years) with a diagnosis of MS underwent a structured telephone interview assessing the five standard diagnostic criteria for RLS. Seventy-six participants underwent Video-polysomnography and Maintenance of Wakefulness Test (MWT). Instrumental and clinical findings were subsequently statistically compared to investigate their association with RLS and PLMS index (PLMSI).
Results: RLS and PLMS (PLMSI ≥15/h) prevalence in patients with MS was of 31.4% and 31.6% respectively. Among patients with RLS, 37.5% had a PLMSI ≥15/h. In the group with PLMS, 37.5% met all diagnostic criteria for RLS. No differences were found between patients with and without RLS ($F = 0.99$, $p = 0.45$), and between patients with and without a PLMSI ≥15/hour ($F = 0.32$ $p = 0.94$) on the pool of clinical and instrumental variables.
Conclusion: RLS is highly prevalent and severe in patients with MS. The prevalence of PLMS is comparable to the general population. The low percentage of patients with RLS having a high PLMSI, together with the absence of correlation between RLS and female gender and older age, support the existence of a distinct symptomatic form of RLS in MS.
Support (if any):

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A CONE-BEAM COMPUTED TOMOGRAPHY STUDY ON THE IMPACT OF BRUXISM IN CRANIOMANDIBULAR MORPHOLOGY OF ADULTS. PRELIMINARY FINDINGS

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Introduction: Although bruxism, either during awake and during sleep is still a controversial topic in contemporary Medicine, its prevalence and its putative relationship with several conditions interfering with health and wellbeing make it relevant as a target to be studied in distinct scientific domains. Histological and morphological on the craniomandibular complex (CC) have been documented with different techniques. However, there is a lack of high quality imaging studies showing structural changes among the different anatomical structures therefore leading to a misinterpretation of the real impact of bruxism on such elements.The aim of this clinical retrospective comparative study was to investigate whether there are structural differences on the craniomandibular complex of bruxers in face to non-bruxers evaluated by a cone-beam computed tomohraphy (CBCT). We present the preliminary findings of this still ongoing study.
Methods: A retrospective analysis of CBCT imaging exams from patients with ages between 18 and 44 years old, were distributed among 1) bruxism group:BG (n=31); 2) Non-bruxism/Control group (n=21). Bruxism diagnosis followed non-instrumental approach suggested by the bruxism consensus 2013. To the craniomorphological evaluation, 3D CBCT SYM Diagnosis protocol was implemented by a calibrated expert at an adequate local with reduced light. Photograpic parameters were analyzed according to standard procedures.
Results: Female gender prevailed without differences between groups (61,3% in BG and 66,7 in CG; p=0,91). Age of BG was significantly higher than CG (40,1 yo versus 28,4;p=0,002). Mandibular structure as inferred by its shape was significantly higher in BG compared with CG.
Conclusion: In this preliminary study the CBCT 3D image showed important and significant changes in mandibular structure in bruxers compared with non-bruxers.
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PREVALENCE AND IMPACT OF RESTLESS LEGS IN PATIENTS WITH MYASTHENIA GRAVIS

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Introduction: Restless legs syndrome (RLS) is a sensori-motor disorder characterized by an urge to move the limbs during inactivity alleviated at least partially by walking/stretching. By contrast, myasthenia gravis (MG) is a neuromuscular disease with fluctuating weakness aggravated by continued muscle activity. Only a few studies addressed the prevalence of RLS in MG patients with limitations related to small sample size and/or usage of non-validated RLS screening tools. The aim of this study was to revisit the prevalence and impact of RLS in a large sample of MG patients using the validated 13-item short-form Cambridge-Hopkins diagnostic questionnaire for RLS (CH-RLSq13).
Methods: The MG foundation of America patient registry was used to survey MG patients. Only patients aged ≥18 years, residing in the USA, and who answered "yes" to the question "Has your doctor diagnosed you with MG?" were included in this study. A survey including the CH-RLSq13, demographic information, disease related history, and patient reported outcomes including the MG15-item Quality of Life (MG-QOL15) and the MG-Activities of Daily Living (MG-ADL) instruments was sent to MG registry participants as part of the semi-annual follow up.
Results: A total of 630 MG patients (age: 62.8±13.2; 54.9% Women; 94.6% White) completed the survey and met eligibility criteria (22% of patients receiving the survey). The prevalence of RLS was 14.8% (93/630). Clinically significant RLS (moderately/extremely distressing RLS ≥2–3 days/week) was present in 53 (8.4%) MG patients. MG patients with (versus without) RLS were significantly younger ($p=0.0061$), more women ($p=0.0440$), with higher (worse) depression ($p<0.0001$), MG-ADL ($p=0.0001$), and MG-QOL15 ($p<0.0001$) scores.
Conclusion: Clinically significant RLS is prevalent in MG patients and is associated with a negative impact on mood, daily activities, and quality of life. Therefore, from a clinical practice it seems warranted to screen for RLS in MG patients.
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REDUCED SYMPATHO-VAGAL RESPONSES TO ORTHOSTATIC STRESS IN DRUG-NAÏVE IDIOPATHIC RESTLESS LEGS SYNDROME

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Introduction: Restless legs syndrome (RLS) is a risk factor for cardiovascular disease (CVD). However, there are no electrophysiological biomarkers to assess this risk. This study aimed to evaluate the heart rate variability (HRV) and autonomic control of cardiovascular reflexes in the supine and standing positions in patients with RLS during wakefulness.
Methods: Fourteen drug-naïve RLS patients (12 women, 2 men; mean age: 42.14 ± 7.81 years) and 10 healthy controls underwent tests for blood pressure, heart rate when in the supine-rest and standing positions, deep breathing, and handgrip in controlled laboratory conditions. Five-minute R-R intervals in each position were collected and analyzed for HRV.
Results: Cardiovascular changes during deep breathing and isometric handgrip maneuvers were normal and similar between the two groups. The normalized unit of the low frequency component and low frequency/high frequency (LH/HF) ratio during standing were lower in the RLS patients than in the controls. LF/HF ratio responses during positional change from supine-rest to standing were significantly reduced in the RLS patients (RLS patients: mean ± SD, 2.94 ± 3.11; controls: 7.51 ± 5.58; P = 0.042). In Spearman's rank correlation, ISI and PSQI were associated with HRV parameters.
Conclusion: The RLS patients showed reduced sympatho-vagal responses during positional change from supine-rest to standing during wakefulness, and RLS-related sleep disturbance was an important contributing factor for autonomic nervous system dysfunction. Reduced HRV responses during wakefulness might be a good predictor for CVD risk.
Support (if any):

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CHARACTERISTICS OF PATIENTS WITH REM SLEEP WITHOUT ATONIA/PERIODIC LIMB MOVEMENTS OF SLEEP WITHOUT DREAM ENACTMENT BEHAVIORS

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Introduction: While REM sleep without atonia (RSWA) in REM sleep behavior disorder (RBD) is associated with male sex, age greater than or equal to 50 years, alpha-synucleinopathies, and narcolepsy, the characteristics of patients with RSWA/persistent periodic limb movements of sleep in REM sleep (RSWA/PLMS-REM) without dream enactment behaviors are unexplored. The aim of this study was to compare the demographics, comorbidities, and concomitant medication use between RSWA/PLMS-REM patients and non-RSWA/non-PLMS-REM controls. Based on anecdotal clinical observations, we hypothesized that these patients are more commonly young, women, have psychiatric or neurological diseases, and use antidepressants.
Methods: We conducted a retrospective review of the Mayo Clinic electronic medical record to identify all patients with RSWA/PLMS-REM between November 2018 and November 2020. After excluding all patients with RBD, restless legs syndrome, narcolepsy, and RSWA/non-PLMS-REM, we identified 27 patients. All in-lab polysomnograms (PSGs) were reviewed to calculate the periodic limb movement index per hour of REM sleep (REM-PLMI). We also identified a control group of 15 individuals without RSWA, reviewed their PSGs, and calculated the REM-PLMI.
Results: The mean REM-PLMI of patients with RSWA was 64 +/- 8.3 (standard error of mean (SEM)) per hour versus 1 +/- 0.6 (SEM) per hour in non-RSWA controls ($p < 0.001$). Patients with RSWA/PLMS-REM and non-RSWA controls had similar age and gender, 62 +/- 3 (SEM) versus 58 +/- 3 (SEM) years and 81% versus 87% men, respectively. However, psychiatric diagnosis, neurological disorders, and antidepressants use were more common among RSWA/PLMS-REM patients compared to non-RSWA controls with $p = 0.0002$, $p = 0.0035$ and $p = 0.0074$ respectively (Fisher's Exact Test).
Conclusion: Psychiatric diagnosis, neurological disorders, and antidepressant use are more common among RSWA/PLMS-REM patients compared to non-RSWA/non-PLMS-REM controls. Further research to determine the implications of a diagnosis of RSWA/PLMS-REM for the future development of alpha-synucleinopathies are needed and currently ongoing.
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NAPS

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Introduction: Rapid Eye Movement (REM) Sleep Behavior Disorder (RBD) is characterized by a lack of muscle atonia during REM sleep with dream enactment. RBD is regarded as a prodromal synucleinopathy as a high proportion of patients eventually phenoconvert to Parkinson's Disease and related synucleinopathies, suggesting RBD may be an early non-motor symptom of disease. Accordingly, patients with RBD are ideally situated to test potential therapeutic interventions to prevent phenoconversion to synucleinopathy. However, RBD itself, and associated patient registries, are rare. The North American Prodromal Synucleinopathy Consortium (formed in 2018) establishes a multisite registry of RBD patients with standardized neurological, neuropsychiatric, and neuropsychological assessments and biomarker collection. The present work reports baseline characteristics of this RBD patient database at its current state.
Methods: Seven participating sites have contributed n=170 polysomnographically-confirmed RBD patients. Data includes past medical and family history, self-report questionnaires, and neuropsychological, motor, sensory, and autonomic function testing. Additionally, all subjects have contributed blood, and a subset of subjects have contributed cerebrospinal fluid samples to the National Centralized Repository for Alzheimer's Disease and Related Dementias for future analysis. A final diagnosis for each subject was determined through an adjudication process by NAPS Consortium PIs; subjects were categorized as ether: 1) isolated RBD, 2) RBD+, 3) Early Symptomatic, or 4) Phenoconverted.

Results: Of the n=170 subjects, there were n=39 isolated RBD, n=81 RBD+, n=45 Early Symptomatic, and n=4 Phenoconverted. Isolated RBD subjects have no other early neurodegeneration signs/symptoms, those with RBD+ have at least one other identifiable early/mild symptom. The early symptomatic group includes those with mild or subjective cognitive impairment, pure autonomic failure, or possible multiple systems atrophy. The Phenoconverted group consists of those with Dementia with Lew Bodies, Dementia NOS, Parkinson's Disease, or Parkinson's NOS. The distribution of impairment across the 5 major domains (motor, cognitive, autonomic, sensory, and psychiatric) for each of the 4 groups will be described.
Conclusion: This interim analysis presents data on n=170 subjects. The target enrollment is n=360 across the 7 original sites plus 3 new sites. Future work will follow these subjects longitudinally to assess rates and predictors of phenoconversion.
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A POPULATION-BASED STUDY OF PHENOCONVERSION TO PARKINSONISM FROM REM SLEEP BEHAVIOR: A POPULATION-BASED STUDY IN THE CLSA

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Introduction: To date, studies have estimated the phenoconversion rate from sleep clinics, using polysomnography proven RBD. However, no population-based estimates have been reported, testing to what degree possible RBD, screened by questionnaire is associated with increased risk of neurodegeneration.
Methods: We included those aged 45–85 years, living in one of 10 Canadian provinces in between 2012–2015 (at the baseline), recruited via three population-based sampling methods. Dream enactment behavior/possible RBD was screened using the RBD1Q single question-questionnaire. De-novo parkinsonism was defined as free of pre-existing diagnosis at the baseline with a 'new' diagnosis at the follow-up (205–2019). Relative risk (log-binomial regression), hazard ratio (Cox regression), incidence rate (Poisson regression) between the affected group and the symptom naïve group were assessed, adjusting for age and sex (and total years of education and language).
Results: Overall, 58 participants phenoconverted into parkinsonism and 53 into dementia at the follow-up (mean intervals=3.06±0.37 years). Participants with dream enactment behavior had 2.75 times higher risk to phenoconvert into parkinsonism than the symptom-free. Similarly, those with dream enactment behavior at the baseline possessed higher risk to screening positive of parkinsonism. No difference in time to phenoconversion was found between groups, The results remained robust after excluding non-RBD related symptoms, such as apnea and non-REM sleep parasomnia.
Conclusion: Compared to symptom-free, those with pRBD had higher risk to developing parkinsonism in near future.
Support (if any):

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CHARACTERISTICS OF AUGMENTED RLS PATIENTS ON DOPAMINE AGONISTS AT A TERTIARY REFERRAL CENTER: WHERE DO WE GO FROM HERE?

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Introduction: Augmentation is a management dilemma in RLS patients on dopaminergic therapy. Understanding the clinical characteristics of such patients may assist in better management strategies.
Methods: Consecutive new consultations for RLS from 4/2016-6/2020 were identified from a single tertiary referral center in Boston, USA. Patients were included in this analysis if they had augmentation and current treatment with a dopamine agonist. Clinical information from initial consultation was collected. RLS severity at time of consultation was determined retrospectively with a modified IRLSSG severity score (0–12), assessing RLS symptom frequency (0–4), duration (0–4), and severity (0–4).
Results: Out of 209 referrals with RLS, 105 patients had augmentation, of whom 88 were on dopamine agonists at initial evaluation. Average age was 67 years (SD 11 years, range 39–88); 62 were female (59%). Mean duration of RLS symptoms was 27 years (SD 20), and 91% had symptoms > 10 years. Mean duration of dopamine agonist therapy was 11 years; 72% had previously been treated with pramipexole, 65% with ropinirole, 73% with rotigotine, and 16% with levodopa; 72% of patients had been treated with alpha-2-delta ligands, and 28% with opioids. Common comorbidities included obstructive sleep apnea (47%), obesity (49%), and depression (44%). Serotonergic medications were currently used by 25%. Of the 88 augmented patients on dopamine agonist therapy, 97% had earlier onset of symptoms and 33% had symptoms in both morning and afternoon; 53% reported anatomical extension. The mean modified IRLSSG score was 8.4 (SD 3.2). 66% of patients had either ferritin <75 mcg/L or transferrin saturation <20%. At the time of initial assessment, 49% were on pramipexole, 47% on rotigotine, 5% on rotigotine and 7% on levodopa: mean daily dopamine agonist dose was 1.23 mg (SD 1.20) of pramipexole equivalent. 37% were on alpha-2-delta ligands: mean daily dose 1014 mg (SD 830, median 700 mg) of gabapentin equivalent.
Conclusion: Higher than FDA-recommended dopamine agonist dosing and high prevalence of iron deficiency in patients with augmented RLS represent a treatment gap in the care of RLS patients in the community. Controlled studies of guideline-based therapy are indicated to determine optimal management of augmented RLS.
Support (if any): Baszucki Brain Research Fund

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PATIENT-REPORTED TREATMENT OUTCOMES IN THE MAYO CLINIC REM SLEEP BEHAVIOR DISORDER REGISTRY: EFFICACY OF MELATONIN AND CLONAZEPAM

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Introduction: REM sleep behavior disorder (RBD) is characterized by disruptive, violent dream enactment behaviors (DEB), necessitating symptomatic treatment to prevent injury and reduce DEB frequency and severity. Melatonin and clonazepam are regarded as RBD therapeutic mainstays, although outcomes data remains limited. We surveyed RBD patients to determine their outcomes following melatonin, clonazepam, and melatonin-clonazepam combination therapy.
Methods: Mayo Clinic RBD Patient Registry participants received an electronic survey concerning treatment type(s) and dose(s), efficacy, and adverse effects. The primary outcome was treatment efficacy, determined by comparing DEB frequency/severity ratings on a visual analog scale (VAS). Adverse effects severity was assessed by Likert

scales. We comparatively analyzed VAS before and after treatment and adverse effects between treatments using non-parametric statistical tests.

Results: Sixty-eight of 109 patients responded (62.3%; 64 had analyzable data) with a mean age of 67.7 years. Fifty-seven (85%) were men, with mean RBD symptom duration of 13.9 years. Patients receiving each treatment were: melatonin=30, clonazepam=8, and combination=12; 14 received other or no treatment. Baseline VAS ratings were similar between groups. Only melatonin (p=0.003) and combination therapy (p=0.039) improved VAS ratings; clonazepam monotherapy did not improve VAS. Only melatonin monotherapy was reported to lower VAS compared to untreated patients (p=0.02). Optimally effective mean dosages were melatonin 9.95±5.06 mg and clonazepam 0.81±0.48 mg. Patient frequencies reporting one or more moderately-severe side effect(s) were similar between melatonin (15%), clonazepam (7%), and combination therapies (9%). Twenty-five (36.8%) patients had received only one medication trial, while 41.2% required more than one medication. Of these, 15 (22.1%) tried 2 and 13 (19.1%) tried 3 or more treatments.

Conclusion: Melatonin therapy at an approximate mean 10 mg dosage improved patient-reported DEB frequency/severity on VAS, compared between both previous intraindividual baseline ratings and with untreated patients, while clonazepam monotherapy did not, without differential adverse effects. Clonazepam monotherapy data were limited. These data inform future prospective melatonin symptomatic therapy trials for RBD. Additionally, 41.2% required more than one RBD pharmacological treatment, suggesting a current therapeutic gap and unmet need for future development of biologically-informed, evidence-based symptomatic RBD therapeutics.

Support (if any):

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REM SLEEP WITHOUT ATONIA IN IDIOPATHIC REM SLEEP BEHAVIOR DISORDER IN THE NORTH AMERICAN PRODROMAL SYNUCLEINOPATHY COHORT

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Introduction: Idiopathic/isolated REM sleep behavior disorder (iRBD) is a prodromal alpha-synucleinopathy characterized by dream enactment behavior and REM sleep without atonia (RSWA). We sought to define quantitative RSWA diagnostic thresholds in the North American Prodromal Synucleinopathy (NAPS) Consortium cohort. We analyzed RSWA between iRBD patients across participating NAPS sleep centers, compared to normative controls, and hypothesized that previous diagnostic RSWA thresholds were overestimates.

Methods: All digital polysomnography files were converted to European Data Format and scored at a central laboratory (Mayo Clinic) which standardized display scoring montages, channel sensitivities, and filtering, and scripted computational analyses for visual scoring. RSWA was quantitatively analyzed in the submentalis (SM) and anterior tibialis (AT) muscles in iRBD (n=86) patients and controls (n=118) utilizing well validated visual (Mayo) and automated (RAI) methods. Parametric statistics were used to compare RSWA metrics, and RSWA thresholds were developed using receiver operating characteristic curves.

Results: RSWA was significantly higher for the RAI and all visual individual and combined muscle activity metrics in iRBD compared to controls (all $p<0.001$). Average SM phasic measures were: 14.2% (Mayo), 17.9% (McGill), 18.5% (UCLA), and 9.4% (Washington University). Average AT phasic measures at each site were: 26.7% (Mayo), 17.1% (McGill), 23.3% (UCLA), and 17.4% (Washington University). Average SM/AT 'any' measures at each site were: 45.4% (Mayo), 35.9% (McGill), 53.4% (UCLA), and 23.5% (Washington University). Overall cohort RBD diagnostic thresholds (AUC, specificity/sensitivity) were: SM phasic 4.9% (90.0, 82.2%/83.7%); AT phasic 7.6% (88.7%, 82.2%/81.4%) and combined SM/AT 'any' 13% (94.6, 83.9%/96.5%).

Conclusion: RSWA thresholds in the NAPS cohort were substantially lower than previously reported, suggesting previously overestimated diagnostic RSWA thresholds due to smaller, enriched patient samples and overfit statistical modeling. Confirmation of these findings in the complete NAPS cohort (n=300 iRBD patients across all 10 NAPS centers) is planned.

Support (if any):

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RESTLESS LEGS SYNDROME PREVALENCE AND SEVERITY AMONG PATIENTS TREATED WITH BUPRENORPHINE AND NALOXONE FOR OPIOID USE DISORDER

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Introduction: Restless Legs Syndrome (RLS) is a sensory-motor neurological disorder which is associated with sleep disturbance and emotional distress. Opioid medications are effective treatments for RLS, and a high percentage of patients undergoing opioid withdrawal exhibit symptoms of RLS. Despite the known connection between RLS and opioids, there has been no assessment of RLS in patients actively treated with buprenorphine and naloxone for opioid use disorder (OUD).

Methods: We conducted a study to determine the prevalence of RLS among patients with OUD at an outpatient buprenorphine and naloxone clinic at Lemuel Shattuck Hospital in Jamaica Plain, Massachusetts. With the help of nurses, participants completed questionnaires which inquired about demographic information, previous opioid use, current medications, and RLS. Patients were categorized as having RLS if, according to the Cambridge-Hopkins Questionnaire, they answered positively to the four essential RLS criteria and if common mimics were not endorsed. A final determination of RLS status in those with ambiguous answers to RLS mimics was made by a trained sleep medicine physician (JWW).

Results: Participants (n=129) were primarily male (n=86; 66.7%), white (n=101; 78.3%), and the median age was 37.5 years. Approximately half of the sample (n=59; 45.7%) used medications for depression and/or anxiety. The median duration of buprenorphine and naloxone use was 3 years. 13.2% were judged to have RLS. RLS symptoms tended to be of moderate severity, disturb sleep to a moderate degree, and occur 5–15 days per month. There were no significant demographic or clinical differences in those with and without RLS. Of the 103 participants without suspected RLS, 15.5% (n=16) were taking a non-opioid medication known to treat RLS symptoms (e.g. gabapentin). Only 1/17 people (5.9%) with RLS were taking a treatment that would control such symptoms.

Conclusion: Approximately 13% of this sample currently taking buprenorphine and naloxone for OUD had RLS. RLS can greatly interfere with sleep and quality of life, and those with untreated or partially treated symptoms may be motivated to use unprescribed opioids to control them. With this in mind, clinicians treating OUD should be aware that there are effective non-opioid medications that can treat RLS.

Support (if any):

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EFFICACY OF A PHYSICAL ACTIVITY INTERVENTION FOR MANAGING RESTLESS LEGS SYNDROME IN MULTIPLE SCLEROSIS: A PILOT RCT

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Introduction: Restless legs syndrome (RLS) occurs in approximately 26% of persons with multiple sclerosis (MS) and can worsen other symptoms of MS, including sleep quality. Physical activity represents a promising approach for managing RLS and its secondary effects in MS. This pilot randomized controlled trial examined the feasibility and efficacy of a physical activity intervention for improving RLS severity and secondary sleep outcomes among a sample of adults with MS.

Methods: Participants with MS (N=15) were randomly assigned into intervention (n=8) or waitlist control (n=7) conditions. The physical activity behavioral intervention was delivered over a 16-week period and outcomes were assessed at baseline and immediately following the 16-week period in both conditions.

Results: There was a significant, positive effect of the intervention on overall RLS severity ($p=.01;\eta\rho2=.43$), RLS severity during the night ($p=.03,\eta\rho2=.35$), RLS severity during the day while resting ($p=.01,\eta\rho2=.44$), and RLS severity during the day while active ($p<.01,\eta\rho2=.61$), and non-significant improvements in RLS severity while falling asleep ($p=.33,\eta\rho2=.09$). There were significant positive effects on sleep satisfaction ($p<.01,\eta\rho2=.49$) and non-significant improvements in self-reported global sleep quality ($p=.35,\eta\rho2=.08$). There was a significant intervention effect on self-reported time in bed ($p=.03,\eta\rho2=.37$) and total sleep time ($p=.03,\eta\rho2=.36$), and non-significant improvements in self-reported sleep latency ($p=.08,\eta\rho2=.25$), sleep efficiency ($p=.27,\eta\rho2=.11$), and daytime sleepiness ($p=.52,\eta\rho2=.04$; $p=.35,\eta\rho2=.08$; $p=.51,\eta\rho2=.04$). There was no significant effect of the intervention on device-measured sleep quality.

Conclusion: This study provides initial evidence for the feasibility and efficacy of a physical activity intervention for reducing RLS severity and possibly self-reported sleep quality outcomes in persons with MS. These preliminary results should inform a future, fully-powered randomized controlled trial that further establishes the efficacy of physical activity for reducing symptoms of RLS and secondary outcomes in a larger sample of adults with MS and RLS.

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TWO-YEAR LONGITUDINAL DATA FROM THE NATIONAL RESTLESS LEGS SYNDROME OPIOID REGISTRY

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Introduction: Restless Legs Syndrome (RLS) is a sensory-motor neurological disorder which is associated with sleep disturbance and emotional distress. Low dose opioid medications are prescribed for treatment-refractory RLS. We now report two-year longitudinal data from the National RLS Opioid Registry, a national sample of patients using opioids for RLS.

Methods: Individuals (n=500) taking a prescribed opioid for diagnosed RLS were enrolled in the registry from 12/2017–9/2019. Information on initial and current opioid dosages, side effects, past and current RLS treatments, and RLS severity was collected by interview at baseline. Follow-up online surveys were performed at six-month intervals for two years.

Results: At the time of analysis, 325 participants had reached two years since enrollment and completed the two-year survey (retention rate=95.3%). There were no mean changes from baseline in RLS symptom severity, sleep, or mood measures. Opioid dose changes from baseline to one- and two-year follow-up were: unchanged (51.2%, 43.1%), increased dose (29.7%, 36.7%), decreased dose (19.1%, 20.2%). Only 7.9% of participants increased dose from baseline at both one and two years. The median dose increase from baseline to two-years was just 10 morphine milligram equivalents (MME). Dose increases of >25 MME occurred in 7.3% of participants (vs 5.2% at one-year) and were independently associated with use of an opioid for a comorbid pain condition in addition to RLS (OR 5.91, p=0.02), discontinuing a non-opioid RLS medication (OR 4.26, p=0.01), and age of 55 or younger at baseline (OR 3.60, p=0.01). Being on an opioid medication for <1 year at baseline was a predictor at one-year follow-up but not during year two of participation.

Conclusion: Prescribed opioid doses remained relatively stable over the two years following enrollment into the registry. Of the 37% of participants that increased dose, over half increased by 10 MME or less. Individuals at the start of opioid treatment for RLS do not see elevated rates of dose increase past the first year of use. Future longitudinal data will improve our understanding of the efficacy and tolerability of opioids for RLS.

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CHARACTERISTICS OF PATIENTS WITH REM SLEEP WITHOUT ATONIA (RSWA)/PERSISTENT PERIODIC LIMB MOVEMENTS OF SLEEP (PLMS) IN REM SLEEP

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Introduction: While RSWA in REM sleep behavior disorder (RBD) is associated with male sex, age > 50 years, alpha-synucleinopathies, and narcolepsy, the characteristics of patients with RSWA/PLMS in REM sleep (RSWA/PLMS-REM) without dream enactment behaviors are unexplored. The aim of this study was to compare the demographics, comorbidities and concomitant medication use between RSWA/PLMS-REM patients and non-RSWA/non-PLMS-REM controls. Based on anecdotal clinical observations we hypothesized that these patients are more commonly young, women, have psychiatric or neurological diseases, and use antidepressants.

Methods: We conducted a retrospective review of the Mayo Clinic electronic medical record to identify all patients with RSWA/ PLMS-REM between November 2018 and November 2020. After excluding all patients with RBD, restless legs syndrome, narcolepsy and RSWA/ non-PLMS-REM we identified 27 patients. All PSGs were reviewed to calculate the periodic limb movement index per hour of REM sleep

(REM-PLMI). We also identified a covenience sample of 15 non-RSWA controls, reviewed their PSGs and calculated REM-PLMI.
Results: The mean REM-PLMI of patients with RSWA was 64+/-8.3 (SEM)/hour versus 1+/-0.6 (SEM)/hours in non-RSWA controls ($p < 0.001$). Patients with RSWA/PLMS-REM and non-RSWA controls had similar age and gender, 62 +/- 3 (SEM) versus 58 +/-3 (SEM) years and 81% versus 87% men, respectively. However psychiatric diagnosis, neurological disorders and antidepressants use was more common among RSWA/PLMS-REM patients compared to non-RSWA controls, $p=0.0002$, $p=0.0035$ and $p=0.0074$, respectively. (Fisher's Exact Test)
Conclusion: Psychiatric diagnosis, neurological disorders and antidepressant use are more common among RSWA/PLM-REM patients compared to non-RSWA controls. Further research to determine the implications of a diagnosis of RSWA/PLMS-REM for the future development of alpha-synucleinopathies are needed and currently ongoing.
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FOOD INSECURITY AND SLEEP HEALTH BY RACE/ETHNICITY AND AGE GROUP IN THE UNITED STATES

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Introduction: Food insecurity may influence sleep through poor mental health (e.g., depression) and immune system suppression. Although prior studies have found food insecurity to be associated with poor sleep, few studies have investigated the food security-sleep association among racially/ethnically diverse participants and with multiple sleep dimensions.
Methods: Using National Health Interview Survey data, we examined overall, age-, sex/gender-, and racial/ethnic-specific associations between food insecurity and sleep health. Food security was categorized as very low, low, marginal, and high. Sleep duration was categorized as very short (<6 hours), short (<7 hours), recommended (7–9 hours), and long (≥9 hours). Sleep disturbances included trouble falling and staying asleep, insomnia symptoms, waking up feeling unrested, and using sleep medication (all ≥3 days/times in the previous week). Adjusting for sociodemographic characteristics and other confounders, we used Poisson regression with robust variance to estimate prevalence ratios (PRs) and 95% confidence intervals (95% CI) for sleep dimensions by very low, low, and marginal vs. high food security.
Results: The 177,435 participants' mean age was 47.2±0.1 years, 52.0% were women, 68.4% were Non-Hispanic (NH)-White. Among individuals reporting very low food security, 75.4% had an annual income of <$35,000 and 60.3% were ≥50 years old. After adjustment, very low vs. high food security was associated with a higher prevalence of very short (PR=2.61 [95%CI: 2.44–2.80]) and short (PR=1.66 [95% CI: 1.60–1.72]) sleep duration. Very low vs. high food security was associated with both trouble falling asleep (PR=2.21 [95% CI: 2.12–2.30]) and trouble staying asleep (PR=1.98 [95% CI: 1.91–2.06]). Very low vs. high food security was associated with higher prevalence of very short sleep duration among Asians (PR=3.64 [95% CI: 2.67–4.97]), Whites (PR=2.73 [95% CI: 2.50–2.99]), Blacks (PR=2.03 [95% CI: 1.80–2.31]), and Hispanic/Latinxs (PR=2.65 [95% CI: 2.30–3.07]).
Conclusion: Food insecurity was associated with poor sleep in a diverse sample of the US population.
Support (if any):

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ASSOCIATIONS BETWEEN MULTIPLE STRESSORS (INCLUDING RACISM) AND SLEEP HEALTH AMONG YOUNG AFRICAN-AMERICAN WOMEN

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Introduction: Stress contributes to poor sleep, and both are associated with adverse mental and physical health outcomes. African-American women are disproportionately burdened by multiple forms of stress as well as poor sleep, but few studies have investigated the stressor-sleep relationship in this population.
Methods: We investigated associations between multiple measures of both stressors and sleep among African American women participating in the Study of Environment, Lifestyle and Fibroids. Using principal components analysis, we summarized 43 items ascertaining self-reported stressors (e.g., racism) and potential mitigators (e.g., resilience). Components were extracted and factor scores generated. Self-reported sleep included short (<7 hours) versus recommended (7–9 hours) sleep, waking unrested 4+ days/week, and insomnia symptoms (>4 nights per month). Adjusting for demographics, health behaviors, and body mass index, we used Poisson regression with robust variance to estimate prevalence ratios (PRs) for each factor score dichotomized at the median.
Results: Among 1,672 women, mean age was 29.2 ± 3.4 years and 45% had a household income <$20,000. We extracted 9 stress factors accounting for 57% of the variance across the 43 items. In order of contribution to explaining the variance, stress factors included emotional distress (e.g., frequency of anger suppression and rumination); racism; social/emotional support; financial strain; medical/crime/family problems; faith/spirituality; resilience; job/home changes; and intimate partner changes/problems. Emotional distress (PR=1.52 [1.35–1.72]), racism (PR=1.28 [1.13, 1.44]), and financial strain (PR=1.14 [1.01–1.29]) were associated with insomnia symptoms. Emotional distress was also related to waking unrested (PR=1.36 [1.26–1.47]) while social/emotional support (PR=0.85 [0.79–0.92]) and resilience (PR=0.88 [0.82–0.95]) were protective. Short sleep was associated with a higher prevalence of emotional distress (PR=1.15 [1.06–1.25]) as well as medical/crime/family problems (PR=1.21 [1.03–1.42]); however, there was a protective association between resilience and short sleep (PR=0.88 [0.82–0.96]).
Conclusion: Multiple stressors were associated with sleep disturbances, but social/emotional support and resilience were associated with more favorable sleep.
Support (if any):

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IS MOTHERS' PERCEIVED PRESSURE ASSOCIATED WITH INFANT SLEEP-RELATED PARENTING PRACTICES?

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Introduction: Studies suggest that feeling pressure about parenting practices is related to higher levels of stress. However, little is known about the pressure mothers feel about infant sleep-related parenting practices. This is surprising, considering that mothers are often exposed to contradictory information about infant sleep. This exploratory study aimed to 1) identify the proportion of mothers of 6-month-old infants who report feeling pressure about their sleep-related parenting practices and 2) assess the relationships between demographic factors and perceived pressure, and between parenting practices and perceived pressure.
Methods: Fifty-four mothers of 6-month-old infants completed a demographic questionnaire and the Sleep Practices Questionnaire (SPQ). Mothers were asked, "Have you ever felt pressure about your parenting choices and practices related to your child's sleep?". Responses ranged from never to always. Linear regressions were conducted to assess the concurrent associations between demographic factors (maternal age, maternal education, parity) and perceived pressure, and between sleep-related parenting practices (feeding method, frequency of bed-sharing, picking up or not picking up the infant when he/she cries at night) and perceived pressure.

Results: Analyses revealed that 5.6% of mothers reported feeling pressure constantly, 20.4% reported feeling pressure quite often, 46.3% reported feeling pressure sometimes, and about a quarter (27.7%) reported feeling pressure rarely or never. Lower maternal education and breastfeeding were associated with feeling more pressure about sleep-related parenting practices ($p < .05$). Furthermore, mothers reporting that they (or their partner) pick up their infant when he/she cries at night were more likely to report feeling pressure ($p < .01$). Maternal age, parity, and frequency of bed-sharing were not associated with feeling pressure ($p > .05$).
Conclusion: The majority of mothers (72.3%) in our sample reported feeling pressure about their sleep-related parenting practices at least sometimes, suggesting that this experience is quite common. Lower maternal education, breastfeeding, and picking up the infant to comfort him/her during the night were associated with higher perceived pressure. Future studies should examine feelings of pressure about sleep-related parenting practices in larger samples of mothers and investigate whether fathers share similar concerns. Moreover, identifying the potential sources of these feelings would represent an interesting clinical avenue.
Support (if any): SSHRC, FRQS

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INSOMNIA SYMPTOMS AND SUBSEQUENT COGNITIVE PERFORMANCE IN OLDER ADULTS: ARE DEPRESSIVE SYMPTOMS AND VASCULAR DISEASE MEDIATORS?

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Introduction: Alzheimer's disease and related dementias (ADRD) are growing public health concerns, and poor sleep may represent a modifiable risk factor. However, there is limited research on insomnia as a predictor of subsequent performance in different cognitive domains and mechanisms that might underlie domain-specific associations. The current study examined: (1) which insomnia symptoms predicted performance across five cognitive domains 14 years later, and (2) whether depressive symptoms and/or vascular diseases mediated these associations.
Methods: Participants included 2,496 adults aged 51+ in the Health and Retirement Study. Insomnia symptoms in 2002 (i.e., "baseline") were quantified by four self-reported items on frequency of trouble falling asleep, nighttime awakenings, early awakenings, and feeling rested upon awakening. Cognition was assessed in 2016 as part of the Harmonized Cognitive Assessment Protocol and operationalized with five factor scores corresponding to episodic memory, executive function, language, visuoconstruction, and processing speed. Multiple regressions examined associations between baseline insomnia symptoms and subsequent cognitive performance, controlling for sociodemographics and baseline global cognitive performance. Mediation models tested whether associations were explained by self-reported depressive symptoms and/or vascular diseases (i.e., hypertension, heart disease, diabetes, and/or stroke) in 2014, controlling for baseline values.
Results: Only trouble falling asleep in 2002 was associated with cognition in 2016. Specifically, more frequent trouble falling asleep predicted poorer episodic memory, executive function, language and processing speed performance, but not visuoconstruction. These associations were mediated by depressive symptoms and vascular diseases in 2014 for all domains except episodic memory; only depressive symptoms mediated the association involving memory. After accounting for these mediators, direct effects of trouble falling asleep remained for episodic memory, executive function and language, but not processing speed.
Conclusion: Difficulty with sleep initiation may be more consequential for later-life cognition than other insomnia symptoms. Depressive symptoms and vascular diseases may partially drive these associations. We speculate that sleep-onset insomnia could mean less total sleep, immune dysfunction, or endocrine effects that worsen mood, vascular health, and cognition. Remaining associations indicate that additional research is needed to characterize other mechanisms through which sleep initiation problems could contribute to later impairments in frontal and temporal cognitive systems, which are implicated early in ADRD.
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SLEEP AND SELF-EFFICACY: THE ROLE OF DOMAIN SPECIFICITY IN PREDICTING SLEEP

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Introduction: Poor sleep occurs across the lifespan and has a number of consequences across biopsychosocial life domains. As such, it is important to identify modifiable psychobehavioral mechanisms contributing to sleep disturbance as potential targets for research and intervention. Self-efficacy may play a significant role in sleep behavior outcomes. The present study aimed to determine the differential associations between general and sleep self-efficacy and sleep among a lifespan sample of adults.
Methods: Data from the Investigating Sleep Longitudinally Across Normal Development (ISLAND) study were utilized for the present investigation. Participants were 3,284 adults (48.5% female, 6.4% other-identifying, Mage= 43 yrs., SD=16.72 yrs.) who completed self-report sleep, general-, and sleep self-efficacy measures as part of their study involvement. A Structural Equation Model (SEM) was estimated to investigate whether general or sleep self-efficacy were significant predictors of a latent sleep disturbance variable, which was comprised of the presence of insomnia symptoms (Insomnia Severity Index) and the absence of sleep health (RU-SATED). Invariance tests were utilized to determine whether the model held across age and sex.
Results: The structural model evidenced good fit to the data and indicated that general self-efficacy did not have a significant, direct impact on the latent sleep construct ($b=-.01$, $p=.33$); however, sleep self-efficacy did display a significant, negative association with sleep disturbance ($b=-.82$, $p<.001$), whereby increased sleep self-efficacy was associated lower levels of disturbed sleep. The model was largely invariant across age and sex.
Conclusion: Sleep self-efficacy surfaced as an important predictor of sleep disturbance above and beyond general self-efficacy. Findings highlight the importance of domain specificity in the predicting sleep outcomes. Additionally, findings suggest the need for increased research into and application of interventions targeted toward increasing sleep self-efficacy in individuals with sleep disturbance as a potential avenue to improve sleep health.
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INTERACTIONS BETWEEN CARDIORESPIRATORY FITNESS AND SLEEP APNEA IN PREDICTING RISK OF ALZHEIMER'S DISEASE

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Introduction: Several studies suggest a link between obstructive sleep apnea (OSA) and Alzheimer's disease (AD). Additionally, frequent exercise is associated with more favorable AD biomarker profiles, and emerging evidence suggests greater cardiorespiratory fitness levels may be associated with lower risk of cognitive decline. We investigated whether cardiorespiratory fitness modifies the association of OSA and risk of AD.
Methods: A subset of the Wisconsin Sleep Cohort study participants with study visits starting in 2000 (n=1182, 46% female, mean [range] age at baseline=57 [37–82] years) completed multiple [range, 1–5] in-laboratory protocols that included overnight polysomnography, anthropometric measurements, and questionnaires. Additionally, the National Death Index was searched to determine cause of death among decedents. Cox proportional hazards models estimated relative hazards of AD (self-reported physician diagnosis or indication of AD on the death certificate) associated with the joint effects and the interaction of OSA – characterized by the base 10 logarithm of the apnea-hypopnea index (log10(AHI+1)) – and cardiorespiratory fitness (an index based on age, sex, BMI, self-reported physical activity, and resting heart rate). Additionally, the sample was stratified by fitness level at the 3rd quartile (>75th percentile compared to <75th percentile) and the hazard ratio for log10(AHI+1) was estimated for the lower and higher fitness-level groups. Results were adjusted for age, sex, BMI, and education.
Results: There were 10 incident cases of AD. The mean [range] fitness level was 7.1 [0–12.3]. 28% of the sample had moderate OSA (AHI 5–15); and 26% had severe OSA (AHI>15). Higher log10(AHI+1) was associated with greater hazards (p=0.03) of AD and there was a significant interaction between log10(AHI) and fitness (p=0.04), such that at greater fitness levels, the effect of log10(AHI) on AD was mitigated. In stratified analysis, among the less fit, the hazard ratio for an increment of 1 in log10(AHI) was 12.8 (95% CI, 1.1–153.8, p=0.04); among those who were more fit, the hazard ratio was not significant.
Conclusion: More severe OSA is associated with higher risk of AD, and this risk is greater among those with lower levels of cardiorespiratory fitness.
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AGE TRENDS IN SLEEP ACROSS THE LIFESPAN: FINDINGS FROM THE PITTSBURGH LIFESPAN SLEEP DATABANK

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Introduction: Sleep continuously changes over the human lifespan and it does so across multiple dimensions, including duration, timing, efficiency, and variability. Although studies focused on specific developmental periods have shown age-related changes in sleep, methodological differences make it difficult to synthesize information across studies to fully understand precisely when these sleep changes occur. Our goal was to use individual-level actigraphy and self-report sleep data from a single site to characterize age trends and sex differences in actigraphy and self-report sleep dimensions across the healthy human lifespan. To accomplish this goal, we developed the Pittsburgh Lifespan Sleep Databank (PLSD), a large aggregate databank of participants from sleep research studies conducted at the University of Pittsburgh.
Methods: In the present analysis, we included N=1,070 PLSD participants from 21 studies without a major psychiatric, sleep, or medical condition. We used Generalized Additive Models to examine flexible, potentially non-linear relationships between age and sleep dimensions (actigraphy and self-report duration, efficiency, and timing; actigraphy variability) from ages 10 to 87. We also examined whether these sleep characteristics differed by sex across the lifespan.
Results: The most dramatic age-related trends were observed in sleep timing. Actigraphy and self-report sleep onset time shifted later between ages 10–18 and then shifted earlier again during the 20s. Actigraphy and self-report wake-up time also shifted earlier during the mid-20s through late 30s. Self-report duration became shorter from approximately ages 10–20. Self-report sleep efficiency and actigraphy variability both decreased over the entire lifespan. Relative to males, females tended to have earlier self-report sleep onset, higher actigraphy sleep efficiency, and longer actigraphy duration.
Conclusion: By focusing on lifespan sleep rather than specific age segments of the samples, we can provide a unified assessment of age-related changes and sex differences from childhood through older adulthood. An understanding of age trends and sex differences in sleep in healthy individuals – and explicating the timing and nature of these difference – can be used to identify periods of sleep-related risk or resilience and guide intervention efforts.
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COGNITIVE HYPERAROUSAL, SLEEP PROBLEMS AND TEMPERAMENT LINKED TO IMPAIRED MATERNAL-INFANT BONDING

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Introduction: Emerging evidence links maternal and infant sleep problems to impairments in the mother-to-infant bond, but the independence and directionality of these associations remain unclear. The present study characterized concurrent and prospective effects of maternal sleep disturbances and poor infant sleep on the mother-infant relationship. As common sequalae of problematic sleep, nocturnal cognitive hyperarousal and daytime sleepiness were investigated as facilitating mechanisms.
Methods: Sociodemographic information and clinical symptoms were measured prenatally then weekly across the first two postpartum months in 67 women. Participants reported insomnia symptoms, sleep duration, snoring, daytime sleepiness, nocturnal cognitive arousal (broadly focused and perinatal-specific), perseverative thinking, depression, infant colic, infant sleep quality, and mother-infant relationship quality. Mixed effects models were conducted to test hypotheses.
Results: Prenatal snoring and weak maternal-fetal attachment augured poorer postpartum bonding. Poor infant sleep was associated with increased odds for maternal insomnia and short sleep. Impairments in the mother-to-infant bond were linked to maternal

insomnia, nocturnal perinatal-focused rumination, daytime sleepiness, depression, and poor infant sleep. Postnatal insomnia predicted future decreases in mother-infant relationship quality, and nocturnal cognitive hyperarousal partially mediated this association.
Conclusion: Both maternal and infant sleep problems were associated with impairments in mother-to-infant bonding, independent of the effects of maternal depression and difficult infant temperament. Perseverative thinking at night, particularly on infant-related concerns, was linked to impaired bonding, rejection and anger, and infant-focused anxiety. Improving maternal and infant sleep, as well as maternal cognitive-emotional regulation, may improve the maternal-to-infant bond.
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OBJECTIVE SLEEP DURATION, SLEEP TIMING AND COMPLETION OF IN VITRO FERTILIZATION CYCLES; A PROSPECTIVE COHORT STUDY

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Introduction: Sleep duration and circadian misalignment have been linked to fertility and fecundability. However, sleep in women undergoing IVF has rarely been examined. This study investigated the role of sleep duration and timing with completion of an IVF cycle.
Methods: Prospective study of women undergoing IVF at a tertiary medical center between 2015 and 2017. Sleep was assessed by wrist-worn actigraphy 1–2 weeks prior to the initiation of their IVF cycle. Reproductive profile, IVF cycle details, demographic and health information were obtained from medical charts. Sleep duration, midpoint and bedtime were examined in relation to IVF cycle completion using logistic regression models, adjusted for age and anti-Müllerian hormone levels. A sub-analysis excluded women who worked non-day shifts to control for circadian misalignment.
Results: A total of 48 women were studied. Median age was 33y (range 25–42), with 29% of women older than 35 years. Ten women had an IVF cycle cancellation prior to embryo transfer. These women had shorter sleep duration, more nocturnal awakenings, lower sleep efficiency, and later sleep timing in comparison to those who completed their cycle. Twenty-minute increases in sleep duration were associated with lower odds of an uncompleted IVF cycle (OR = 0.88; 95% CI 0.78, 1.00). Women with later sleep midpoints and later bedtime had higher odds of an uncompleted cycle relative to those with earlier midpoints and earlier bedtime; OR=1.24; 95% CI 1.09, 1.40 and OR=1.33; 95% CI 1.17, 1.53 respectively, per 20-minute increments. These results were independent of age, levels of anti-Müllerian hormone, or sleep duration, and remained unchanged after exclusion of shift-working women.
Conclusion: This study demonstrated the influence of sleep duration and sleep timing on the odds of an uncompleted IVF cycle prior to embryo transfer. Sleep is a modifiable behavior that may contribute to IVF cycle success.
Support (if any):

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EEG-BASED DEEP NEURAL NETWORK MODEL FOR BRAIN AGE PREDICTION AND ITS ASSOCIATION WITH PATIENT HEALTH CONDITIONS

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Introduction: Electroencephalogram (EEG) provides clinically relevant information for personalized patient health evaluation and comprehensive assessment of sleep. EEG-based indices have been associated with neurodegenerative conditions, psychiatric disorders, and metabolic and cardiovascular disease, and hold promise as a biomarker for brain health.
Methods: A deep neural network (DNN) model was trained to predict the age of patients using raw EEG signals recorded during clinical polysomnography (PSG). The DNN was trained on N=126,241 PSGs, validated on N=6,638, and tested on a holdout set of N=1,172. The holdout dataset included several categories of patient demographic and diagnostic parameters, allowing us to examine the association between brain age and a variety of medical conditions. Brain age was assessed by subtracting the individual's chronological brain age from their EEG-predicted brain age (Brain Age Index; BAI), and then taking the absolute value of this variable (Absolute Brain Age Index; ABAI). We then constructed two regression models to test the relationship between BAI/ABAI and the following list of patient parameters: sex, BMI, depression, alcohol/drug problems, memory/concentration problems, epilepsy/seizures, diabetes, stroke, severe excessive daytime sleepiness (e.g., Epworth Sleepiness Scale ≥ 16; EDS), apnea-hypopnea index (AHI), arousal index (ArI), and sleep efficiency (SE).
Results: The DNN brain age model produced a mean absolute error of 4.604 and a Pearson's r value of 0.933 which surpass the performance of prior research. In our regression analyses, we found a statistically significant relationship between the ABAI and: epilepsy and seizure disorders, stroke, elevated AHI, elevated ArI, and low SE (all $p<0.05$). This demonstrates these health conditions are associated with deviations of one's predicted brain age from their chronological brain age. We also found patients with diabetes, depression, severe EDS, hypertension, and/or memory and concentration problems showed, on average, an elevated BAI compared to the healthy population sample (all $p<0.05$).
Conclusion: We show DNNs can accurately predict the brain age of healthy patients based on their raw, PSG derived, EEG recordings. Furthermore, we reveal indices, such as BAI and ABAI, display unique characteristics within different diseased populations, highlighting their potential value as novel diagnostic biomarker and potential "vital sign" of brain health.
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BURDEN OF SLEEP DISTURBANCE IN BLACK PREGNANT WOMEN

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Introduction: Black women disproportionately experience poor perinatal outcomes compared to other racial/ethnic groups. Poor sleep has emerged as a strong contributor to adverse pregnancy outcomes and, in the non-pregnant population, sleep-wake disturbances have a high prevalence with often greater severity among Blacks. Nonetheless, the majority of studies have included largely White populations which has restricted our understanding of race-specific burdens and morbidities of sleep disturbance. The goal was to describe the burden of sleep-wake disturbance in Black pregnant women and associations with pregnancy outcomes.

Methods: Black women at least 18years and >28 weeks pregnant were recruited from prenatal clinics. All women completed questionnaires about their sleep including the presence and timing of habitual-snoring (pre-pregnancy or pregnancy-onset), the Epworth Sleepiness Scale (ESS), and the General Sleep Disturbances Scale (GSDS) to determine poor sleep quality and poor daytime function as well as symptoms of insomnia. We also analyzed three commonly-reported sleep problems as individual question items (difficulty getting to sleep, wake up during sleep period, and wake up too early at the end of a sleep period). Demographic information and diagnoses were abstracted from medical records.
Results: Overall, 235 women enrolled; mean age was 27.6 + 6.2 years, mean BMI 31.7 + 9.8kg/m2, and 64% were in receipt of Medicaid. Eighty-percent of women reported >three sleep-wake disturbances, and almost half experienced a burden of >five disturbances. Women with pregnancy-onset habitual-snoring (but not those with pre-pregnancy habitual-snoring) had increased odds of poor sleep quality aOR 8.2 (95% CI 1.9, 35.9), trouble staying asleep aOR 3.6 (95% CI 1.0, 12.5), waking up too early aOR 2.7 (95% CI 1.1, 6.2), excessive daytime sleepiness aOR 2.3 (95% CI 1.1, 4.7), and poor daytime function aOR 8.7 (95% CI 2.5, 29.9). In contrast, women with pre-pregnancy habitual-snoring had increased odds for chronic hypertension, preterm delivery and fetal growth restriction; aOR 2.6 (95% CI 1.1, 6.3), aOR 2.8 (95% CI 1.1, 6.9), and aOR 5.1 (95% CI 1.7, 15.2), respectively.
Conclusion: Black women have a significant burden of sleep-wake disturbances. These findings highlight the excess risk that habitual-snoring confers to sleep-wake disturbances and perinatal outcomes in an infrequently studied yet highly vulnerable population.
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ACTIGRAPHIC SLEEP PARAMETERS AND ANXIETY SYMPTOMS AMONG COMMUNITY-DWELLING OLDER ADULTS

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Introduction: A number of cross-sectional studies have found that elevated levels of anxiety are associated with poor sleep among healthy older adults, but most have used self-reported sleep measures. We investigated the longitudinal association between objectively measured sleep (by wrist actigraphy) and subsequent change in anxiety symptoms in this population.
Methods: We studied 555 community-dwelling older adults (mean age 72.52±7.35, 77.48% white, 53.15% women) in the National Social Health and Aging Project (NSHAP) study who completed 3 nights of wrist actigraphy at wave 2 (2010–2011) and the Hospital Anxiety and Depression Scale at waves 2 and 3 (2015–2016). Actigraphic sleep parameters were averaged across nights and included: total sleep time (TST; minutes), percent sleep (%), wake after sleep onset (WASO; minutes), and sleep fragmentation. Change in anxiety was calculated as the difference between anxiety scores at wave 3 and wave 2.
Results: After adjusting for age, race, sex, education, body mass index, number of medical conditions, depression symptoms, and anxiety scores at wave 2, we found no significant associations between any actigraphic sleep parameter and subsequent change in anxiety symptoms (all $p \geq 0.390$). Additional analyses revealed no significant cross-sectional associations at wave 2 ($p \geq 0.390$).
Conclusion: We found no evidence for an association between actigraphic sleep and anxiety symptoms, or change in anxiety symptoms, in community-dwelling older adults. Additional studies using clinical anxiety disorder diagnoses are needed to evaluate the extent to which objectively measured sleep disturbance predicts clinically significant anxiety in older adults.
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ASSOCIATION OF PERSONALITY TRAITS WITH NAPPING BEHAVIORS IN OLDER ADULTS

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Introduction: Greater neuroticism and lower conscientiousness are linked to poorer nighttime sleep among older adults, but little is known about the association between personality and daytime sleep. Napping increases in older adulthood, and napping has been linked to health outcomes, including cognitive impairment. Thus, it is important to extend personality and sleep research to investigate napping behavior. We examined the association between personality and napping in a nationally representative cohort of older adults.
Methods: We studied 742 adults aged ≥65 years from the National Health and Aging Trends Study (NHATS) who completed the sleep and personality modules in NHATS rounds 3 or 4 (2013–2014). Personality dimensions (neuroticism, extraversion, openness, agreeableness, conscientiousness) were assessed by the Midlife Development Inventory Personality Scales. Participants reported nap frequency over the past month (most days or everyday [nappers-frequent]; some days [nappers-infrequent]; rarely/never [non-nappers]); napping intention (intentional/unintentional); and average nap duration (coded as ≤40 minutes [short]; and >40 minutes [long], consistent with previous studies). Personality dimensions were included together in all models. Model 1 adjusted for age, sex, education, and BMI, and Model 2 further adjusted for anxiety and depression, comorbidities, sleep medications, and nighttime sleep duration. Only nappers were included in models with nap frequency, intention, or duration as outcomes (n=387).
Results: There were no personality differences between nappers and non-nappers. Among nappers, however, higher neuroticism was associated with lower odds of frequent naps (OR=0.73, 95% CI: 0.55,0.97), and higher agreeableness was associated with greater odds of unintentional napping (OR=1.95, 95% CI:1.12, 3.41) and lower odds of long nap duration (OR=0.54, 95% CI:0.33, 0.90) in Model 1. Associations remained in Model 2. Higher neuroticism was also associated with greater odds of long nap duration in Model 1 (OR=1.40, 95% CI:1.03, 1.91), but not after further adjustment in Model 2.
Conclusion: This is, to our knowledge, the first study examining the association between personality and daytime napping behaviors among a large sample of older adults, extending the literature on personality and nighttime sleep in this population. Because napping behaviors are associated with health outcomes, personality may be an important factor to consider in interventions addressing napping.
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EARLIER-LIFE SLEEP PATTERNS AND RISK FOR DELIRIUM IN ELDERLY HOSPITALIZED PATIENTS FROM A 14-YEAR LONGITUDINAL COHORT

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Introduction: Delirium is an acute decline in attention and cognition that is associated with cognitive dysfunction in elderly patients. While accumulating evidence points to associations between sleep disturbances and neurocognitive disorders, the temporal relationship between sleep patterns and delirium remains unclear. We tested whether earlier-life sleep duration, daytime dozing, insomnia, and sleep apnea predict incident delirium during hospitalization.
Methods: We studied 315,989 participants (mean age 58.3±7.9; range 37.4–73.7) from the UK Biobank with up to 14 years follow-up, and at least one hospitalization episode. Delirium diagnosis was derived using ICD-10 coding from hospitalization records. Multivariate logistic regression models examined the associations of self-reported baseline sleep duration (less than 6h/6-9h/more than 9h), daytime dozing (often/rarely), insomnia (often/rarely), and presence of prior sleep apnea (ICD-10), with incident delirium. Models were adjusted for age, sex, education, Townsend deprivation index, and major confounders (including number of hospitalizations during follow-up, BMI, neurological/cardiovascular/respiratory diseases, depression/anxiety, chronotype, and sedatives).
Results: 4,025 developed delirium (12.7/1,000). There was a U-shaped association between sleep duration and delirium, where short [17.3/1,000; OR 1.18, 95% CI: 1.05–1.33, p=0.006] and long (28.8/1,000; OR 1.49, 95% CI: 1.30–1.70, p<0.001) sleepers had elevated risk compared to regular 6-9h sleepers. Often daytime dozing (25.3/1,000; OR 1.38, 95% CI: 1.20–1.58, p<0.001) and sleep apnea (21.7/1,000; OR 1.21, 95% CI: 1.03–1.42 p=0.02) also had increased the risk for delirium, but the latter was attenuated by the inclusion of BMI and hypertension. However, we did observe further risk when two or more of the above traits were present (OR 1.59, 95% CI: 1.29–1.95 p<0.001). No effects on incident delirium were observed from insomnia.
Conclusion: Earlier-life sleep patterns, in particular longer sleep and daytime dozing, are associated with an increased risk for delirium. Sleep patterns may reflect unmeasured health status; further work is warranted to confirm the associations using objective sleep/circadian measures, examine underlying mechanisms, and test whether optimizing sleep patterns can reduce the risk of developing delirium.
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PREDICTING PERCEIVED FUNCTIONAL LIMITATION IN MIDLIFE AND OLDER ADULTHOOD: THE ROLE OF SLEEP AND PERCEIVED CONTROL

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Introduction: Functional limitations become increasingly common and debilitating as individuals age, potentially impacting several facets of well-being. As such, it is important to understand malleable factors that may potentially impact functional limitation outcomes. Both sleep and perceived control have been linked to the development of functional limitation. The current study sought to clarify the unique contributions of both sleep quality and perceived control to functional limitation status in middle-aged and older adults.
Methods: Data from the second wave of the Midlife in the United States study were used for the current study. Participants included 527 participants (59.9% female, Mage=59.83 years, SD=9.75 years) who completed measures of functional limitation levels (Functional Status Questionnaire), subjective sleep quality (Pittsburg Sleep Quality Index), and perceived control (MIDI Sense of Control Scales). A hierarchical regression analysis was conducted to examine sleep quality and perceived control as predictors in a unique model for predicting functional limitation. Demographic variables of age, gender, and race were used as covariates in study analyses.
Results: The overall model predicted 19.0% of the variance in functional limitation levels. Sleep quality was significantly associated with self-reported functional limitation (β=-.27, p<.001) over and above perceived control (β=.20, p<.001). Specifically, findings indicate that worse sleep quality is associated with increased functional limitation, while higher levels of perceived control are associated with lower levels of functional limitation.
Conclusion: Though perceived control is known to be associated with functional limitation status, the present study suggests a unique effect of sleep quality on functional limitation even after accounting for perceived control. Due to the potential for negative effects of functional limitation in middle-aged to older adults, it is important to identify and target constructs for research and intervention related to the development of these limitations. Care models for individuals who report experiencing functional limitations may benefit from targeting sleep health and control beliefs in intervention and assessment.
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ASSOCIATIONS OF BEDTIME, WAKE-TIME AND EMPLOYMENT STATUS BY GENDER AND RACE

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Introduction: Poor sleep quality has been reported in the unemployed compared with employed. How sleep varies by employment status has been rarely examined at a population level. Therefore, we investigated sleep-wake patterns among employed, unemployed but actively seeking a job, and not-in-the-labor-force participants by gender and race/ethnicity.
Methods: Methods We used data from the American Time Use Survey (ATUS), a nationally representative sample of US residents aged ≥15years, which records weekday/weekend activities in a 24-hour period (4:00am-4:00am). This sample was restricted to participants aged 25–60 years (n=130,062). This analysis utilized functional nonparametric regression based on dimension reduction and neighborhood matching. We modeled the relationship between participant-specific sleep-wake trajectories, coded by minute, and employment status. Implementing the counterfactual approach, we estimated the effects of each employment scenario on participant-level expected sleep trajectory. This approach allowed the examination of hypothetical sleep-wake trajectories for each participant if their employment status differed from the observed. We then marginalized these findings to gender and race/ethnic subpopulations, controlling for confounders and secular trends.
Results: Mean age was 42□0.01 years, nearly half (51%) of participants were women and 68% were Whites. The proportions of employed, unemployed, and not-in-the-labor-force were 79%, 16.5% and 4.5%, respectively. On average, unemployed and not-in-the-labor-force participants had a later bedtime and wake-time compared with employed. With the exception of Whites, each individual race/ethnicity group

showed pronounced differences in sleep-wake patterns by employment status. Of note, the likelihood of still being asleep up to 9:00am was greater when unemployed in comparison to had they been employed. Compared with employed, differences in sleep-wake patterns were pronounced among Blacks and Hispanics had they been unemployed, but attenuated if they were out-of-the-labor-force. Gender alone was not a strong moderator of the relationship between sleep-wake patterns and employment status. Unemployed participants had bedtime after 11pm, regardless of gender or race/ethnicity.

Conclusion: Using the counterfactual approach, we predicted sleep-wake patterns among individuals had they been employed, unemployed, or out-of-the-labor-force by gender and race/ethnicity. Though cross-sectional, our data suggest that the sleep schedules of racial/ethnic minorities in comparison to Whites may be more affected by employment status.

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LARYNGOMALACIA AND OBSTRUCTIVE SLEEP APNEA IN INFANTS WITH PWS

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Introduction: Growth hormone (GH) improves tone, body composition, development, and growth in infants with Prader-Willi Syndrome (PWS). Concerns about sudden death following GH initiation and worsening obstructive sleep apnea (OSA) in children with PWS resulted in guidelines for polysomnography (PSG) evaluation before and after starting GH. We review novel evidence of laryngomalacia as a mechanism for this worsening of OSA and describe the incidence of laryngomalacia in this patient population.
Methods: A retrospective review of infants and children seen at the Seattle Children's PWS clinic between October 2014 and May 2020 who had undergone polysomnography (PSG) before and after growth hormone initiation was performed. Findings on otolaryngology evaluation via flexible fiberoptic laryngoscopy (FFL) or drug-induced sleep endoscopy were reviewed to characterize obstruction, diagnosis of laryngomalacia, and response to surgical intervention.
Results: A total of 28 cases were identified. 12 (41%) were evaluated with FFL between ages 4 and 21 months old (median 5) for noisy breathing, worsening or persistent OSA, or dysphagia. Out of these, 9 (75% of FFL, 31% of total) were diagnosed with laryngomalacia. Children with laryngomalacia were more likely to have worsening of OSA after GH initiation. Surgical interventions including supraglottoplasty or adenotonsillectomy led to improvement in OSA in 86% of children who had worsening after GH initiation.
Conclusion: Worsening OSA after GH initiation is seen in 38% of patients with PWS. Laryngomalacia is a common comorbid condition and more frequent in those with worsening OSA after GH initiation that is amenable to targeted surgical intervention.
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OUTCOMES OF SICKLE CELL CRISIS IN RELATION TO PEDIATRIC OBSTRUCTIVE SLEEP APNEA IN THE UNITED STATES: A US POPULATION COHORT STUDY

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Introduction: This study aimed to quantify the impact of obstructive sleep apnea (OSA) on the mortality, morbidity, and resources utilization among children admitted with Sickle cell crisis (SCC)
Methods: This is a retrospective analysis using the 2016 and 2017 National Inpatient Sample Database. The Inclusion Criteria was a principal Diagnosis of SSC and age <18 years. OSA, as a Secondary Diagnosis, was identified using the appropriate ICD-10 CM codes. The Primary Outcomes were Inpatient Mortality, and secondary outcomes were: In-Hospital Length of Stay(LOS), Total hospitalization Cost, Blood transfusion (BT) requirement, and a requirement for Invasive mechanical ventilation (IMV). We used Multivariate Linear/ logistic regression to adjust for confounders including age and sex.
Results: Out of 36,484 children with SSC included in the study, 1450 children had OSA (SCC+OSA). SSC-OSA and SSC+OSA groups did not differ in gender, household income, and hospital characteristics, but did so in age (11.3 vs 12.4; p <0.001). OSA was most common in the age group of 13–18 (54%) and lowest in 0–4 (2.4%). Compared to SSC-OSA, the SCC+OSA cohort had significantly higher odds of mortality (adjusted OR= 11.9, [95% Confidence Interval: 1.02- 138.8],p=0.04). Additionally, SSC+OSA cohort was associated with increased odds of IMV (aOR=5.24 [CI: 1.84 – 14.8], p=0.002), longer LOS (adjusted mean difference (aMD)=0.67 [CI-0.32 – 1.02], p=<0.001), and higher hospitalization Cost (aMD=2818.76 [CI-1680- 4157], p=<0.001). No difference in BT (aOR=0.94 [CI: 0.68 – 1.29], p=0.71) was noted.
Conclusion: This study demonstrates that the presence of OSA is associated with detrimental outcomes in SSC with higher in-hospital mortality, higher morbidity (Invasive mechanical ventilation rate), and higher resource utilization (LOS, total hospitalization cost). More attention to the screening, early diagnosis, and appropriate treatment of OSA is imperative to improve health outcomes in children with sickle cell disease.
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IMPACT OF ADENOTONSILLECTOMY ON GROWTH TRAJECTORIES IN PRESCHOOL CHILDREN WITH MILD OBSTRUCTIVE SLEEP APNEA

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Introduction: Adenotonsillectomy forms part of first-line management for pediatric obstructive sleep apnea (OSA). In nonrandomized studies of preschool-aged children, it is associated with postoperative weight gain. Being overweight or obese in childhood is a predictor of cardiovascular and metabolic disease in later life. Using longitudinal data from a multicenter randomised controlled trial, we assessed the impact of adenotonsillectomy on growth trajectory in preschool-aged children with mild-moderate OSA. Secondary aims were to assess the influence of social factors and baseline polysomnography parameters on growth trajectory.
Methods: A total of 190 children (aged 3–5 years) with obstructive apnea hypopnea index ≤10 were randomly assigned to early (within 2 months) or routine (12-month wait) adenotonsillectomy. Anthropometry and polysomnography were performed at baseline, 12-month and 24-month timepoints for 126 children. Social risk factors were recorded using a questionnaire. Baseline characteristics were compared using a Mann-Whitney or t-test for continuous variables, and Fisher's exact test for categorical variables. Data were analyzed using linear mixed modelling.
Results: Demographic and polysomnographic parameters were similar between groups at baseline. Baseline body mass index (BMI) z-score was 0.52 for both groups. For BMI z-score, there was a significant increase in the early surgery group between 0 and 12 months (0.4, 95%CI 0.1–0.8) but not from 12–24 months. For the routine surgery group, there was a significant BMI z-score increase following surgery between 12 and 24 months (0.45, 95%CI 0.1–0.8), but not from 0–12 months. Final BMI z-score was similar between the two groups. Findings for weight-for-age z-score were similar to the abovementioned findings for BMI z-score. Height-for-age z-score was not significantly different between different timepoints or intervention groups. Children with an unemployed primary income earner had a higher BMI z-score than those with a full-time employed income earner. No other social risk or polysomnography parameters were statistically significant.
Conclusion: This study provides randomized controlled trial evidence of notable weight increase in preschool children with milder spectrum OSA that occurs in the months immediately following adenotonsillectomy. For children undergoing adenotonsillectomy, counselling regarding nutritional intake and exercise alongside weight

monitoring should be considered, especially for those already at risk of becoming overweight or obese.
Support (if any):

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ASSESSMENT OF SLEEP DISORDERS IN CHILDREN AND ADOLESCENTS WITH OBESITY

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Introduction: When studying the inherent aspects of sleep it is important to assess how the quality and quantity of sleep in the last two decades may be one of the reasons for the increase in childhood obesity, which has been growing rapidly worldwide. This study aims to assess the presence of sleep disorders in overweight children and adolescents.
Methods: An descriptive study was conducted with data collection from 43 patients between 6 and 13 years old diagnosed as overweight. They were patients of a specialized service for children and adolescents with obesity that is part of the Hospital de Clínicas of the Federal University of Paraná, located in Curitiba, Brazil. To investigate the presence of sleep disorders, the Sleep Disturbance Scale for Children (SDSC) questionnaire was administered. The factors assessed were: Disorders of Initiating and Maintaining Sleep, Sleep Breathing Disorders, Disorders of Arousallnightmures, Sleep Wake Transition Disorders, Disorders of Excessive Somnolence and Sleep Hyperhydrosis.
Results: The mean age of the patients that took part in the research was 10 years and 7 months (± 1.95). The mean BMI of the participants was 29.57 kg/m2 (± 4.38), the majority being diagnosed with obesity. The sum of all SDSC factors demonstrated the presence of pathological sleep in 58.1% (25) of the sample, whereas 51.2% (22) of the patients had Sleep Breathing Disorders and 58.1% (25) had the Sleep Wake Transition Disorder.
Conclusion: The present study demonstrated the presence of sleep disorders in overweight children and adolescents. As for Sleep Respiratory Disorder, a situation has already been advocated in the current literature for this audience. In relation to the Sleep-Wake Transition Disorder and pathological sleep, further research is needed to prove the presence of the disorder in other groups studied. Here is the suggestion that future research be done with subjective and objective data collection on sleep within a larger sample, in order to confirm the association between sleep disorders and childhood obesity.
Support (if any):

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UTILIZATION OF PEDIATRIC SLEEP QUESTIONNAIRE TO SCREEN FOR OBSTRUCTIVE SLEEP APNEA IN A DIFFICULT-TO-TREAT ASTHMA COHORT

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Introduction: Early detection and management of obstructive sleep apnea(OSA) could improve asthma control in children with difficult-to-treat(DTT) asthma. The purpose of this study was to assess the effectiveness of the pediatric sleep questionnaire(PSQ) to screen for OSA in children with DTT asthma, and to compare clinical characteristics between those with positive and negative PSQ scores.
Methods: A prospective study of 81 children with DTT asthma was completed from 2015–2017. The PSQ, Epworth sleepiness scale(ESS), Pediatric Quality of Life(PQL), and the academic performance questionnaires(APQ) were administered during clinic visits. Polysomnography(PSG) was recommended for PSQ score>0.33. Medical records were reviewed for asthma clinical characteristics. The cohort was separated into positive(PSQ>0.33) and negative PSQ score(PSQ≤0.33) groups for analysis.
Results: The mean age of the cohort was 11.3±4.5 years and the mean body mass index was 22±7.6 kg/m2. Sixty-two percent were male and 68% were African-American. Forty-nine(53%) subjects had positive PSQ (0.5[0.4 – 0.7]). The positive group had higher ESS score (10.5[8 – 13] vs. 6[2 – 8], p<0.0001) and lower total PQL score (58.7[47.8–72.8] vs. 79.4[70.7 – 87], p<0.0001) than the negative group. There was no difference between APQ scores(p=0.07). The positive group had lower asthma control test(ACT) scores than the negative group (17.5[15 – 20.5] vs. 21[19 – 22], p<0.0001). Furthermore, the positive group was more likely to have gastroesophageal reflux (OR: 3.97, 95%CI: 1.7 to 9.1, p=0.0018). Twenty-nine(59%) subjects in the positive group had subsequent PSG, and 17(58.6%) subjects were diagnosed with OSA (14 mild OSA, 1 moderate OSA, 2 severe OSA). The mean obstructive index in the positive group was 3±5.5 events/hour. There was 1 subject with central apnea and alveolar hypoventilation. Of the 17 subjects with OSA, all received treatment with nasal steroids, 3 were treated with non-invasive positive pressure ventilation, and 4 had surgical intervention.
Conclusion: Children with DTT asthma who have positive PSQ have higher degree of daytime sleepiness, lower quality of life and worse asthma control. The positive group was more likely to have GERD, which may suggest a relationship between nighttime asthma symptoms and OSA. Further studies are needed to evaluate the effects of OSA treatment on asthma control.
Support (if any):

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ROLE OF X-RAY SOFT TISSUE NECK IN CHILDREN WITH OBSTRUCTIVE SLEEP APNEA WITH A PREVIOUS HISTORY OF ADENOTONSILLECTOMY

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Introduction: Adenoid recurrence in children after adenotonsillectomy can be an etiology for obstructive sleep apnea (OSA). The aim of this study was to assess the role of x-ray soft tissue neck (XR-STN) in evaluating adenoid recurrence from a sleep physician perspective and to assess the polysomnographic findings of pre and post revision adenoidectomy.
Methods: This was a single center retrospective study that included children <18 years old with a history of adenotonsillectomy who underwent sleep study that confirmed the diagnosis of OSA and had XR- STN to evaluate for adenoidal tissue recurrence at the University of Louisville/Norton Pediatric Sleep Disorders clinic from July 2012 to September 2020. XR-STN level of adenoidal obliteration, baseline and post revision adenoidectomy PSG data were analyzed.
Results: A total of 160 subjects were included in the study with a mean age of 9.71±3.5 years, 59.4% were male, 54.4% were Caucasians, and the mean z-score was 1.77±1.15. XR-STN was normal in 39.4% of the subjects and it showed mild, moderate, and complete adenoidal obliteration in 20.6%, 32.5% and 7.5% of the subjects, respectively. Multiple regression analysis showed that the total AHI, the mean for

the moderate and complete adenoidal obliteration are significantly higher than children with no obstruction (p-value=000). However, mild obliteration, Z score, age, gender, and race were not significantly associated with an increased total AHI. Pre- and post- adenoid revision PSGs were available in 20 subjects and they showed significant improvement in AHI (10.4±12.9 vs. 21.1±23.9, p=0.04), arousal index (15.4 ±10.6 vs. 21.1± 14.9, p=0.04), and nadir SaO2 (86.7%±8.1 vs. 76.58% ±18.44, p=0.04).
Conclusion: Soft tissue neck x-ray was useful in assessing adenoid recurrence in our study. Revision adenoidectomy resulted in an overall improvement in several PSGs parameters of OSA. Pediatric sleep physicians may consider XR-STN in the evaluation of children with OSA with a previous history of adenotonsillectomy.
Support (if any): None

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LOST TO FOLLOW-UP: POST-OPERATIVE POLYSOMNOGRAPHY IN HIGH-RISK, PEDIATRIC OSAS

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Introduction: Post-operative polysomnography (PSG) is recommended in certain pediatric populations at risk for residual sleep disordered breathing: moderate to severe obstructive sleep apnea syndrome (OSAS), obesity, craniofacial abnormalities, and neurologic disorders. In light of multiple stakeholders involved in follow-up management, variability in completion of a post-operative PSG may exist. We hypothesize that patients with isolated severe OSAS or severe plus a co-morbidity will have greater incidence of a post-operative PSG.
Methods: A chart review of 373 pediatric patients revealed 67 patients who met inclusion criteria for our high-risk cohort. Chart review included the presence of an ENT, Primary Care, or Sleep Medicine encounter, time to follow-up, the presence of a post-operative PSG, time to post-operative PSG, and the presence of an annual follow-up with any provider.
Results: Although 83% of our cohort followed-up with any provider, only 31% completed a post-operative PSG. Patients consistently followed-up with ENT 6–8 weeks postoperatively (76%) and haphazardly followed-up with primary care (38%). All patients with a Sleep Medicine follow-up (19%, n=13) completed a post-operative PSG, with 11 of the 13 occurring within 1 year from surgery. There was no significant difference across isolated moderate, isolated severe, or moderate/severe with a comorbidity for incidence of follow-up by specialty, annual follow-up, or post-operative PSG completion. However, patients with isolated severe (AHI >10) completed a PSG on average 13.5 weeks post-operatively which was significantly sooner than 36.2 weeks for isolated moderate OSA (p=0.04).
Conclusion: Although Sleep Medicine providers may consistently follow AASM practice parameters, variability exists for which patients return to complete a post-operative PSG. Severity of OSAS or presence of a concerning co-morbidity does not seem to correlate with acquiring a postoperative PSG. An inconsistent standard across disciplines may contribute to this discrepancy. These findings will inform future quality improvement discussions with key stakeholders. In light of this baseline assessment, we plan to recommend a standardized, multidisciplinary care pathway for the management of high-risk, pediatric OSAS.
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NASAL CAVITY NARROWING IN PEDIATRIC OBSTRUCTIVE SLEEP APNEA

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Introduction: The contribution of nasal cavity narrowing to obstructive sleep apnea (OSA) in children has not been well-defined. Acoustic rhinometry is a non-invasive technique that uses acoustic pulses to measure nasal cavity cross-sectional area (CSA) at defined distances from the tip of the naris. This study evaluated the relationship between nasal cavity CSA and OSA in children. We hypothesized that OSA severity would correlate with reduced nasal CSA.
Methods: Children 5–12 years of age with OSA underwent polysomnography and acoustic rhinometry at baseline and after 3 months and 12 months of growth as part of a randomized controlled trial. Statistical analysis of the nasal cavity CSA up to 6 cm from the tip of the naris was performed using mixed-effects linear regression model with visit month, age at visit, trial number, OSA severity, and side (left or right naris), and statistical interaction between OAHI category and distance from the tip of the nose as a fixed effect and the random effects set on the level of individual subject. Least significant differences were used to account for multiple comparisons. An unbiased approach using latent class analysis was used to determine OSA severity categories based on obstructive apnea hypopnea index (OAHI). Post-hoc analysis was used assess the model adjusted (marginal) means and pairwise effects.
Results: 112 participants completed testing (50% male, aged 7.9±2.1 years). Median (IQR) OAHI for subjects with mild OSA (n=69) was 4.4/hr (3.2), moderate OSA (n=35) was 9.7/hr (7.1), and severe OSA (n=8) was 21.3/hr (17.2). There was a significant difference in linear trend for nasal cavity narrowing of the CSA between patients with mild vs. moderate OSA, p=0.023. There was no difference in nasal cavity narrowing between the severe group and other groups, likely due to the small sample size of this group.
Conclusion: There is a difference in the anterior nasal cavity narrowing between children with mild OSA and moderate OSA. In addition to structural narrowing from adenotonsillar hypertrophy, this may be another contributor to pediatric OSA.
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A SURFACE ELECTRODE ADJACENT TO VAGAL NERVE STIMULATOR LEAD CAN AID IN CHARACTERIZING VNS MEDIATED SLEEP DISORDERED BREATHING

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Introduction: Vagal nerve stimulators (VNS) are a nonpharmacological treatment for patients with refractory epilepsy. The VNS can decrease seizure frequency by over 75% in 40% of pediatric patients with refractory epilepsy. An underrecognized side effect is sleep disordered breathing (SDB). The purpose of this study was to demonstrate how a sensor placed adjacent to the VNS lead can distinguish whether SDB is due to VNS discharge.
Methods: Five pediatric patients (ages: 5–8) with refractory epilepsy with VNS were referred to our sleep center for concern for SDB. Each patient underwent a polysomnogram (PSG) that included a standard

PSG montage with a surface electrode placed adjacent to their left lateral neck to detect VNS discharge. VNS associated apnea hypopnea index (vAHI) was calculated by determining the number of hypopneas and obstructive apneas occurring during VNS discharge.
Results: Of the 5 patients, three met pediatric criteria for obstructive sleep apnea (OSA). Patient 1 had an obstructive AHI (oAHI) of 21.3 events/hr with a vAHI accounting for 79% of the total (16.8 events/hr), patient 2 had an oAHI of 16.6 events/hr with a vAHI accounting for 57% of the total (9.5 events/hr), and patient 3 had an oAHI of 1.9 events/hr with vAHI accounting for 68% of the total (1.3 events/hr). Because of these findings, the VNS settings of all 3 patients were changed with the goal of reducing SDB due to VNS discharge. Upon repeat PSG, patient 2 had reduced OSA with an oAHI of 3 events/hr, with no events associated with VNS discharge. The remaining 2 patients did not exhibit VNS associated SDB, however, both experienced increased respiratory rate during VNS discharge.
Conclusion: We demonstrated that a surface electrode adjacent to the VNS is able to temporally co-register VNS discharges and enabled us to directly correlate SDB to VNS stimulation in 3 patients with refractory epilepsy. Because of our findings, we titrated the VNS parameters in all 3 patients, with one showing resolution of VNS associated SDB on repeat PSG. We propose that an added surface electrode to detect VNS discharge be considered as standard practice in PSG studies of patients with VNS.
Support (if any):

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EFFECT OF WEEKLY TEXT MESSAGE FEEDBACK ON CONTINUOUS POSITIVE AIRWAY PRESSURE ADHERENCE IN PEDIATRIC OBSTRUCTIVE SLEEP APNEA

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Introduction: Continuous Positive Airway Pressure (CPAP) is an effective treatment for Obstructive Sleep Apnea (OSA) in children. However, adherence to CPAP therapy is often suboptimal. CPAP telemonitoring with automated feedback messaging has been shown to improved adherence in adults with OSA, but has not been widely studied as an intervention for children with OSA. This pilot study was conducted to investigate if feedback messaging could similarly improve CPAP adherence in children.
Methods: Pediatric OSA subjects (ages 11–17) with poor CPAP compliance or newly prescribed CPAP were selected from an outpatient Sleep Medicine clinic to receive weekly text messages with scripted feedback on CPAP adherence. Patients already meeting adherence goals were excluded from the study. Parental consent was obtained and participants were given the option to have text messages sent to parents or directly to the patient. Adherence was monitored over a four-month intervention period and compared to pre-intervention usage as a self-matched control. Total hours of use per month and numbers of days used per month were collected through daily remote CPAP monitoring. Average hours per use and average daily use per 30-day period were additional adherence measurements calculated. Data was analyzed using two-tailed paired T-tests with level of significance set at $p<0.05$.
Results: There was no significant change in CPAP adherence ($p>.05$) after initiation of weekly feedback messaging for the five patients included in the study. No participant, before or after intervention, met the Medicare definition of compliance (≥4hr nightly use for ≥ 70% of nights) and average adherence declined following intervention.
Conclusion: In a small pilot study, weekly feedback text messaging did not improve CPAP adherence in pediatric patients with OSA. This finding contrasts with larger studies in adult patients with OSA that have demonstrated improved CPAP adherence with automated feedback messaging. With the increasing use of telemedicine for CPAP follow-up, new strategies to successfully utilize this approach in the pediatric population may be needed.
Support (if any): None.

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INFANT OSA: IMPACT ON GROWTH AND DEVELOPMENT OUTCOMES

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Introduction: Obstructive sleep apnea (OSA) related growth and developmental deficits were previously described in young children. However, growth and development outcomes of OSA in infants is not as clear.
Methods: We retrospectively reviewed polysomnography (PSGs) of infants 0–12 months of age done at one tertiary care, urban medical center, between 2012–2019. Indications for the studies were symptoms or high risk for OSA. Diagnosis of OSA was determined when obstructive apnea hypopnea index (oAHI) >1/hr. Demographic information and physician diagnosed developmental and growth delays were collected from medical records.
Results: A total of 83 infants were included, mean age was 4.4months (6 days-12 months). Mean baseline oAHI was 16.8/hr (1–91.46/hr). 23 patients were noted to have failure to thrive (27.7%), 27 patients had general developmental delay (32.5%), 22 patients had speech delay (26.5%), and 9 patients had motor delay (10.8%). Out of all the patients with any form of delay (N=46), 39.13% were premature, 71.73% had an underlying neurologic abnormality and 39.13% had some other underlying diagnosed syndrome. 2 patients had delay but no associated comorbidity. Patients without any developmental delay showed trend towards likelihood of more severe OSA compared to patients with any delay ($p=0.0455$).
Conclusion: Infant OSA is a separate entity from pediatric OSA and requires a better understanding of its association with developmental outcomes. Infants are particularly vulnerable to obstructive sleep-disordered breathing related to their upper airway anatomy, adverse pulmonary mechanics and a REM-predominant sleep state distribution. We describe a cohort of 83 infants undergoing PSGs in their 1st year of life with developmental and growth follow up until 2nd year of life. Most of the infants with moderate to severe OSA had some delay in their development. Infants without diagnosed delay, were less likely to have severe OSA. It remains unclear to what degree OSA is responsible for these findings as opposed to pre-existing comorbidities. Additional prospective, controlled studies with standardized developmental assessments are warranted to assess causality.
Support (if any):

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ASSOCIATION OF 25-HYDROXYVITAMIN D AND OBSTRUCTIVE SLEEP APNEA IN ADOLESCENT BARIATRIC SURGERY PATIENTS

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Introduction: Obstructive sleep apnea (OSA) is a frequent comorbidity found in children with obesity. However, body mass index (BMI) as a single indicator does not reliably predict the presence of disease. There are no screening tools available which effectively risk stratify pediatric patients to determine the necessity of referral for a sleep study. Recent studies show an association between Vitamin D

and OSA in adults, however few studies have examined this potential association in children. In this study we investigate the association of Vitamin D and OSA in pediatric patients.

Methods: We retrospectively reviewed the medical records of adolescent participants referred to our institution's bariatric program over a two-year period. Inclusion criteria included documentation in the medical record of an initial bariatric clinic assessment, overnight diagnostic polysomnography (PSG) and comprehensive laboratory testing which included serum analysis of lipid profile, hemoglobin A1C, fasting glucose, iron panel, liver function enzymes, and 25-hydroxyvitamin D (25(OH)D) plasma levels. The metabolic profiles and polysomnographic data of patients with and without OSA were compared.

Results: Sixty medical records were reviewed, of which 40 participants were identified that met our inclusion criteria. Participants were grouped according to OSA severity (negative 17%; mild 32%; moderate 32%; severe 12%). There was no significant difference in age, gender or BMI in those with and without OSA (mean age 16.8 ± 0.6 versus 16.2 ± 1.5 years, p=0.13; male gender 32% versus 38%; and BMI 50.5± 5.4 kg/m2 versus 50.17±11.9 kg/m2, p=0.89, respectively). Metabolic profiles for 25(OH)D levels inversely trended with OSA severity (no OSA 21.3± 6.6, mild 17.6± 6.4, moderate 19.5± 5.6, severe 13.25± 5.5, p=0.13). Participants with severe OSA had significantly lower 25(OH)D plasma levels compared to participants without OSA (13.25 ± 5.5 versus 21.3 ± 6.6 ng/ml, p <0.03).

Conclusion: Vitamin D levels inversely correlate with OSA severity in severely obese adolescent patients, and may severe as a useful biomarker in the detection of disease.

Support (if any):

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ADENOID REGROWTH AFTER RAPID MAXILLARY EXPANSION IN RESIDUAL PEDIATRIC OSA: INTERIM ANALYSIS OF ERMES RANDOMIZED CLINICAL TRIAL

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Introduction: Residual pediatric Obstructive Sleep Apnea (OSA) after gold-standard treatment with adenotonsillectomy occurs in nearly 20% of the patients. Treatment alternatives are scarce and based upon low-level evidence. Rapid maxillary expansion is an orthodontic-orthopaedic treatment of maxillary transverse hypoplasia that has shown promising results in pediatric OSA based upon nasal and oral cavity enlargement. Revision adenoidectomy of all-purpose adenotonsillectomies in population-based studies is 4,9%, and a threefold risk in OSA patients has been reported. We present data from an ongoing randomized clinical trial (ERMES) highlighting the importance of nasofibroscopic control of the adenoid tissue in residual pediatric OSA patients.

Methods: According to the study protocol of our ongoing randomized clinical trial (Rapid maxillary expansion for treatment of residual pediatric obstructive sleep apnea; Acronym: ERMES; NCT02947464) patients aged 4 to 9 years old with polysomnographic evidence of OSA persistence after adenotonsillectomy were randomized to either rapid maxillary expansion or wahtchful waiting. They underwent fiberoptic nasopharingoscopy in order to stablish the amount of adenoidal tissue present at the time of inclusion and at polysomnographic control twelve months later. The nasopharyngeal occupation was measured in a 1 to 4 scale. Patients that graded 3 or 4 at the initial nasofibroscopy were excluded from the study due to their surgical revision indication; if they developed grade 3 or 4 adenoid hypertrophy and persistence of symptoms at the final assesment they were offered re-adenoidectomy.

Results: A total of 5 patients developed an adenoid regrowth amenable for revision surgery: 4 of them within the rapid maxillary expansion group and one in the watchful waiting group. All of them had experienced either worsening or very mild improvement in their apnea hypopnea index (AHI).

Conclusion: Adenoid regrowth is a known risk factor for pediatric OSA persistence. The anatomical enlargement of the nasal and oral cavity provided by means of rapid maxillary expansion may trigger such overgrowth in otherwise predisposed residual OSA patients. Fiberoptic nasopharyngoscopy is therefore mandatory in the follow-up of such complex cases, since adenoid regrowth may hinder resolution of OSA and its associated symptoms.

Support (if any): ERMES Randomized Clincal Trial (NCT02947464) is funded by Departamento de Salud del Gobierno Vasco.

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EFFECT OF PHOX2B GENOTYPE AND AGE ON HEART RATE VARIABILITY IN PEDIATRIC PATIENTS WITH CONGENITAL CENTRAL HYPOVENTILATION SYNDROME

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Introduction: Congenital Central Hypoventilation Syndrome (CCHS) is a rare neurocristopathy causing a wide array of cardiac autonomic nervous system (ANS) abnormalities (abnormal heart rate (HR) regulation, decreased HR variability (HRV), prolonged sinus pauses). CCHS is caused by mutations throughout the PHOX2B gene. Different types and locations of PHOX2B mutations have been associated with different levels of CCHS cardiac phenotype severity. We hypothesized that HRV in CCHS will be influenced by age and PHOX2B genotype.

Methods: PHOX2B mutation-confirmed CCHS patients in our cohort followed longitudinally with serial Holter monitoring were included. HRV measures were extracted from Holter monitoring reports and analyzed using linear mixed-effect models. Additional analyses explored which variables predicted sinus pauses and cardiac pacemaker implantation using linear and logistic regression. Only data preceding implantation of a cardiac pacemaker were included in analysis.

Results: 97 patients (0–18 years old) were enrolled in the study: 21 with the 20/25 genotype, 21 with the 20/26 genotype, 26 with the 20/27 genotype, 7 with genotypes ranging from 20/28-20/33, and 22 with non-polyalanine repeat expansion mutations (NPARMs). There were 965 total observations (Holters). The following HRV metrics were analyzed: min- and max-HR, longest-RR, SDNN, ASDNN5, SDANN5, and RMSDD. Statistically significant differences were observed between PHOX2B genotypes for min-HR and longest-RR (ps<0.05). Age by genotype interactions emerged such that certain metrics in HRV had different developmental trajectories by genotype (ps<0.05). Min-HR and longest-RR predicted eventual cardiac pacemaker implantation (AUCs>0.78). As for predictors of sinus pauses, different HRV metrics emerged as predictors across PHOX2B genotypes suggesting their utility in predicting cardiac pacemaker implantation dependent on genotype.

Conclusion: HRV in patients with CCHS is dependent on age and PHOX2B genotype, with significant differences in HRV metrics between patients with PHOX2B genotypes 20/25, 20/26, and 20/27 and

the patients with 20/28-20/33 genotypes as well as those with NPARMs. Consistent with treatment guidelines, min-HR and longest-RR were predictive of eventual cardiac pacemaker implantation. Differences in the HRV metrics which predict sinus pauses as well as the overall group differences observed and trajectory-based differences may improve anticipatory management by earlier risk identification for prolonged sinus pauses in CCHS.

Support (if any): None

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PATIENT CHARACTARESTICS WITH NORMAL TO MILD APNEA HYPOPNEA INDEX UNDERGOING POLYSOMNOGRAPHY TO DIAGNOSE OBSTRUCTIVE SLEEP APNEA

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Introduction: Polysomnography (PSG) testing is expensive and not easily accessible. Waiting time for a routine PSG at the Alberta Children's Hospital (ACH) can be up to a year. Majority of PSG studies performed are for diagnosis of obstructive sleep apnea (OSA). A previous quality improvement (QI) project conducted at the ACH showed that two-thirds of children who had undergone initial PSG testing had an apnea hypopnea index (AHI) in the normal or mild range. Given our limited resources, better characterization of patient referral characteristics and process factors as documented on the PSG requisition will inform our triage process, decrease wait time, improve resource allocation and information provided to referral sources.

Methods: Retrospective review of PSG's performed for the initial diagnosis of OSA was completed between January 2018 and March 2020 at the ACH. Patient referral characteristics (age, sex, growth parameters, medical diagnosis, indication for PSG, previous airway surgery), process factors (source of referral, PSG referral and completion date, triage status) and AHI were recorded. Patients were divided into two groups (group A: normal and mild; group B: moderate and severe) based on AHI. Data obtained from the groupings were compared and analyzed descriptively. PSG triage to completion time was also calculated for each group.

Results: A total of 798 initial PSG studies were completed between January 2018 and March 2020. Of the PSG's reviewed 64.8% were in group A and 35.2% were in group B. Common medical diagnoses in group A included ADHD, Asthma and Autism, whereas group B had T21 and Enuresis. History of previous airway surgery did not differ between groups.

Conclusion: Further clarification of the patient's underlying medical diagnosis (referral characteristic) may help inform our triage process. The implication of previous airway surgery (process factor) on AHI severity is unclear at this point. More data is actively being collected to further interrogate these preliminary findings.

Support (if any):

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ADHERENCE TO AUTO-TITRATING CPAP IN CHILDREN WITH TRISOMY 21 AND OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is common in children with trisomy 21. The pathophysiology can be multifactorial and challenging to manage. Auto-titrating continuous positive airway pressure (autoCPAP) is an emerging tool for the treatment of pediatric OSA and few studies discuss adherence. This study compares autoCPAP adherence in children with and without trisomy 21 at our center. We hypothesized that autoCPAP adherence would not differ between the two groups.

Methods: A retrospective review of patients aged 0 to 18 years with a diagnosis of OSA as defined by the International Classification of Sleep Disorders Third Edition, and empirically prescribed autoCPAP between 2012 and 2020 was conducted. Patients without available polysomnography or adherence data were excluded. Data included patient demographics, baseline polysomnography characteristics, and autoCPAP usage. Adherence was defined as usage ≥ 4 hours/night on 70% of nights during a consecutive 30-day period as per the Centers for Medicare and Medicaid Services criteria. Descriptive statistics and non-parametric tests were utilized for analysis.

Results: There were 130 total patients included with a mean age of 12.5 years ± a standard deviation of 4.1 years. Seventeen children (13%) had trisomy 21. No statistically significant differences were observed between the trisomy 21 group (T21) and the non-trisomy 21 group (non-T21) with respect to the obstructive apnea hypopnea index (9.5 ± 11.2 in T21, 14.7 ± 22.3 in non-T21, p=0.61), or the oxygen saturation nadir (87.8% ± 4.2% in T21, 84.4% ± 10.8% in non-T21, p=0.57). The percentage of days used ≥ 4 hours in a 30-day period did not significantly differ (52.3% ± 42% in T21, and 49.5% ± 37.5% in non-T21, p=0.64). While 41% of T21 subsequently underwent a CPAP titration for a suboptimal response to autoCPAP (for reasons including intolerance, persistent snoring, or daytime sleepiness), this did not differ significantly from 23% in non-T21 (p=0.11).

Conclusion: Although limited by a small sample size, our data suggest that adherence to autoCPAP did not differ between the trisomy 21 and non-trisomy 21 groups of children with OSA. Empiric autoCPAP is a reasonable treatment option for children with OSA who are not surgical candidates, including those with trisomy 21.

Support (if any):

566

PERSISTENT SLEEP APNEA AND DESATURATION IN PRETERM CHILDREN AT 18 MONTHS OF AGE AT HIGH ALTITUDE (2640 M)

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Introduction: Children born at term who live at high altitude (HA) (≥ 2500 m) have different respiratory patterns from those that live at sea level. It is essential to determine these patterns in preterm children due to their high risk of Sleep Apnea-Hypopnea Syndrome (SAHS). The evolution of the apnea hypopnea index (AHI), desaturation index (ODI), and oxygen saturation (SpO2) is unknown in this group at HA. The objective was to characterize the respiratory patterns during sleep of preterm children living at HA and compare it with those of healthy children born at term.

Methods: We conducted a cross-sectional study in Bogotá, Colombia (altitude: 2640 m). We included 302 children, 127 were preterm with an average of gestational age of 31weeks (SD: 2.9) and an average weight at birth of 1600 g (SD: 594) and 175 healthy full-term infants. Three groups were defined according to age: Group I: 3–4 months,

Group II: 6–7 months,, Group III: 10–18 months. All children underwent nocturnal polysomnogram to evaluate their respiratory variables: AHI, average and minimum SpO2, ODI, and T90 during sleep and analyzed the data according to the parameters of the American Academy of Sleep Medicine

Results: 302 polysomnograms were performed, 54.3% were girls and were distributed by groups as follows: Group I:105 patients (34.8%), 16 preterm, Group II: 107 patients (35.4%), 46 preterm and Group III: 90 patients (29.8%), 65 preterm. We observed higher respiratory parameters within each age strata in premature infants compared to children born at term. Preterm infants had higher ODI, AHI, obstructive apnea hypopnea index (O-AHI), and Central Apnea hypopnea index (C-AHI). Although the effect decreases over time, we found a significant difference in the first age group. There was a high persistence index in children with a history of preterm birth living at high altitude. We also found a significant decrease in AHI, ODI across time in healthy and preterm children $p<0.01$

Conclusion: Premature children living at HA persist with higher ODI and AHI compared to children of similar ages born at term. The high desaturation index indicates the presence of intermittent hypoxia that persists in these children over time

Support (if any):

567

VALIDITY OF SLEEP RELATED BREATHING DISORDER SCALE AND ANTHROPOMETRICS IN OBESE/ OVERWEIGHT CHILDREN WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Prevalence of OSA, a multifactorial disorder associated with significant morbidity, has increased due to the pediatric obesity epidemic. A key existing gap is lack of a valid OSA screening tool in overweight/obese pediatric patients incorporating anthropometrics. Our aim is to examine the validity of inclusion of anthropometrics to the existing SRBD scale to detect moderate (apnea hypopnea index-AHI≥5) or severe OSA(AHI≥10).

Methods: Consecutive obese/overweight(n=89) patients(body mass index-BMI percentile>85th for age/gender) in obesity management clinic with SRBD scale, polysomnogram(PSG) and anthropometrics (neck circumference (NC),waist circumferences(WC), height), systolic and diastolic blood pressure(BP) percentiles are included. Receiver operating characteristic(ROC) analysis with AHI as the outcome variable, sensitivity, specificity, positive(PPV), negative predictive values(NPV) for an SRBD cutoff score of 8 and SRBD score found using Youden's index in ROC and 95% confidence intervals using the exact binomial method are presented. Prediction model, interaction and discrimination (Outcome:AHI; Independent: age, sex, WC, NC, SRBD) were analyzed.

Results: Study population characteristics: age 12.6±3.4years, 55% female, 62% non-white and AHI=13.0±20.7,AHI>5=65.1% and AHI>10=37.1%. No significant differences were noted in item endorsement or SRBD total score using either AHI≥5 or AHI≥10 (all P>0.10). The area under the ROC curve for SRBD detecting AHI≥5 and 10 was 0.491(95%CI=0.352–0.630) and 0.559(95%CI=0.439–0.679). SRBD≥8 had sensitivity 0.759(0.628–0.861), specificity 0.387(0.218–0.578), PPV 0.698(0.570–0.808), NPV 0.462(0.266–0.666), for AHI≥5 and for AHI≥10, 0.848(0.681–0.949), 0.375(0.249–0.515), 0.444(0.319–0.575), 0.808(0.606–0.934) respectively. The SRBD cutoff score for Youden's index was 7 for both AHI cutoffs of 5 and 10 and produced similar results to using SRBD cutoff score of 8. The prediction models including age, sex and WC (NC was not significant) had optimism-corrected c-statistics of 0.724 and 0.627 for AHI≥5 and 10, respectively. Adding SRBD total score to the models actually reduced these values to 0.702 and 0.614.

Conclusion: SRBD alone has fair sensitivity, but poor specificity for significant OSA in overweight/obese. The addition of anthropometrics to SRBD decreased discrimination of OSA in prediction models. Anthropometrics may differ in pre pubertal and post pubertal phenotypes of OSA and may or may not aid in increasing predictability of OSA with SRBD.

Support (if any):

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SLEEP EVALUATION IN DOWN SYNDROME: WHAT IS THE ADHERENCE TO AMERICAN ACADEMY OF PEDIATRICS DS GUIDELINES?

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Introduction: Specialized health care guidelines for children with Down Syndrome (DS) published by the American Academy of Pediatrics (AAP) provided specific recommendations based on the higher risk needs of individuals with DS. Obstructive sleep apnea (OSA) is reported to be present in 50–79% of individuals with DS. According to the AAP guideline, all individuals with DS should have a polysomnography (PSG) evaluating for OSA by 4 years old and then screened by history and physical exam annually thereafter. An interim analysis of an ongoing Down Syndrome Research study was evaluated to determine rate of adherence to these guidelines.

Methods: The Dimensional, Sleep, and Genomic Analyses of Down Syndrome to Elucidate Phenotypic Variability study enrolled down syndrome patients 30 months and older, as well as first degree relatives to participate. Patients completed a standardized clinical sleep interview, childhood sleep habits questionnaire and was asked to complete 2 week sleep diary, actigraphy and polysomnography. We aimed to characterize the rate of PSG completion by 4 years of age, number of research PSGs completed and rate of OSA identified on research PSG.

Results: A total of 31 patients were consented. The median patient age was 10 years old with a slight female predominance (15F:12M). 27 patients completed the sleep interview and 19 successfully completed a scorable polysomnography. Only 7 patients had completed a PSG previously by age of 4 years. 11 of 19 studies demonstrated obstructive sleep apnea ranging from mild to severe severity (1.7–42.5/hr). REM AHI (range 1.2–58.2/hr, mean 19/hr and median 12.3/hr) demonstrated increased severity.

Conclusion: Despite AAP guidelines recommending universal PSG evaluation by the age of 4 years of age, only 26% of patients interviewed has a PSG successfully completed previously. Additional recommendations by AAP include yearly surveillance of symptoms although there is poor correlation between parent report and polysomnogram results. Of the 19 research completed PSGs, 58% demonstrated OSA with the mean and median results consistent with moderate to severe OSA and worsening during REM sleep. Improved effort to successfully obtain PSG in this population is needed. Further study is ongoing to evaluate the relationship to other health and cognitive outcomes.

Support (if any): NIMH

569

CORRELATION BETWEEN AGE AND INITIAL FINDINGS OF SLEEP DISORDERED BREATHING IN CHILDREN WITH ACHONDROPLASIA

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Introduction: Achondroplasia (ACH) occurs approximately 1 in 20,000–30,000 live births. They are prone to sleep disordered breathing specifically due to the upper airway stenosis, enlarged head circumference, combined with hypotonia and limited chest wall size associated with scoliosis at times. The co-occurrence of sleep apnea is well established and can aide in the decision for surgical intervention, however it is unclear at what age children should be evaluated for sleep apnea. Screening is often delayed as during the daytime there is no obvious gas exchange abnormalities. Due to the rareness of this disease, large studies are not available, limiting the data for discussion and analysis to develop guidelines on ideal screening age for sleep disordered breathing in children with ACH.
Methods: The primary aim of this study is to ascertain the presence of sleep disorder breathing and demographics of children with ACH at time of first polysomnogram (PSG) completed at one of the largest pediatric sleep lab in the country. The secondary aim of the study is to identify whether subsequent polysomnograms were completed if surgical interventions occurred and how the studies differed over time with and without intervention. Retrospective review of the PSGs from patients with ACH, completed from 2017–2019 at the Children's Sleep Disorders Center in Dallas, TX. Clinical data, demographics, PSG findings and occurrence of interventions were collected.
Results: Twenty-seven patients with the diagnosis of ACH met criteria. The average age at the time of their first diagnostic PSG was at 31.6 months of age (2.7 years), of those patients 85% had obstructive sleep apnea (OSA),51% had hypoxemia and 18% had hypercapnia by their first diagnostic sleep study. Of those with OSA, 50% were severe. Majority were females, 55%. Most of our patients were Hispanic (14%), Caucasian (9%), Asian (2%), Other (2%), Black (0%). Each patient had an average of 1.9 PSGs completed.
Conclusion: Our findings can help create a foundation for discussion of screening guidelines. These guidelines will serve to guide primary care physicians to direct these patients to an early diagnosis and treatment of sleep disordered breathing.
Support (if any):

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COMPARING NIV ADHERENCE IN EARLY VERSUS ADVANCED STAGE SLEEP DISORDERED BREATHING FOR CHILDREN WITH NEUROMUSCULAR DISEASE

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Introduction: Children with neuromuscular disease (NMD) typically develop progressive sleep disordered breathing (SDB), including obstructive sleep apnea (OSA), nocturnal hypoxemia and/or hypoventilation, due to loss of upper airway muscle tone and weakness of respiratory muscles. Commonly, the SDB initially presents during rapid eye movement (REM) sleep, as this stage is associated with physiological muscle atonia, but then progresses to non-REM (NREM) sleep and ultimately daytime respiratory insufficiency. Non-invasive ventilation (NIV) is currently the treatment of choice for children with NMD and SDB. However, the use of NIV in REM-related SDB is less demonstrated and adequate therapy adherence is unclear. The aim of this study is to determine differences in NIV adherence in children with early (REM) versus advanced (non-REM) SDB.
Methods: Children (0–18 years) diagnosed with NMD and using NIV for the past 10 years were included. Demographic, clinical, technology-related, and sleep study data were collected from medical charts and polysomnography reports. Adherence data (mean hours of NIV use and % days NIV was used >4hrs) were collected from NIV machine downloads. Children were categorized into two groups based on based on their apnea-hypopnea index (AHI) ratio between REM and NREM sleep. Children with REM-SDB were defined as a REM/NREM AHI ratio of ≥ 2. Children with NREM-SDB were defined as a REM/NREM AHI ratio < 2.
Results: A total of 14 children (9 REM-SDB and 5 NREM-SDB) were included in the analysis. Both groups were comparable with respect to demographic, clinical, and technology-related characteristics. A total of 24 adherence reports were available for the cohort (16 REM-SDB and 8 NREM-SDB). The mean hours of NIV use per night was comparable between the REM-SDB and NREM-SDB groups (9.2±1.3hrs vs. 9.0±0.4hrs respectively), but the percent days NIV was used >4hrs was higher in the NREM-SDB group (68.7±9.6 vs. 93.0±2.7, p=0.03).
Conclusion: NIV adherence was high for children with both REM-SDB and NREM-SDB. While hours of NIV use were comparable between both groups, suggesting good NIV tolerance through the night, children with REM-SDB had a lower percentage of days with NIV use >4hr, suggesting less willingness to use the therapy.
Support (if any):

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EVALUATING NEED FOR FOLLOW UP POLYSOMNOGRAMS AFTER ADENOTONSILLECTOMY IN CHILDREN

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Introduction: Most children with Obstructive sleep apnea (OSA) undergo repeat polysomnogram (PSG) following adenotonsillectomy (T & A). Repeat PSG is often performed regardless of presence of symptoms of sleep disordered breathing after T & A. PSG data performed before and after T & A performed at our institution over past 2 years were reviewed. Data was collected on patient characteristics such as age, sex, BMI, comorbidities and AHI on pre-T & A study. Data was then analyzed looking at patient characteristics that can help predict significant OSA (AHI >5) in post T & A study.
Methods: Retrospective review of 50 consecutive PSGs before and after T & A performed at our institution over past 2 years was performed. Data was collected on age, sex, Obstructive AHI, BMI, O2 nadir and comorbidities to identify patient characteristics to predict significant OSA (AHI>5) in the post T & A study.
Results: Age range of our cohort was 2–16 years. Average age and BMI of our cohort was 5.8 years (median 5 years) and 16.6 respectively. 8 patients had significant OSA (AHI>5) in the after T & A study. AHI (>20) and increased BMI z-score at baseline was highly predictive of significant OSA (AHI>5) in the after T & A study.
Conclusion: Based on our data, follow up PSG is warranted if AHI is >20/hour on baseline diagnostic PSG. Similarly, high BMI z-score at baseline study is also highly predictive of significant OSA (AHI>5) in the post T & A study. Most children with associated comorbidities with mild (AHI 2–5 hour), moderate (AHI 5–10/hour) and lower end of severe OSA (AHI 10–20/hour) do not need repeat PSG after T & A unless symptoms of sleep disordered breathing are present. We are analyzing larger PSG database to identify other patient characteristics that may signal need for follow up PSG. As PSGs are expensive and time consuming, follow up PSGs should be performed only if clinical suspicion for residual OSA is high to optimize resource utilization.
Support (if any):

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UTILITY OF SPLIT NIGHT POLYSOMNOGRAMS IN CHILDREN

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Introduction: Overnight in-lab polysomnograms (PSG) are the gold standard for diagnosis of sleep disordered breathing in children. As the wait time for adenotonsillectomy (T & A) at our institution was several months, we implemented split night PSGs with positive airway pressure (PAP) during the initial diagnostic PSG if AHI>30 (Emergency SNPSG). Planned SNPSG were performed on children who are undergoing PSG after T & A, eliminating follow-up titration PSG if the PSG is positive for OSA (residual AHI>10/hour). We present data on the outcomes of the SNPSG.
Methods: Retrospective chart review of consecutive SNPSGs done over last 2 years at our institution was performed. Data on SNPSGs (planned or emergency), age, sex, diagnostic study duration, diagnostic study AHI, PAP pressure and subsequent PAP adherence were collected. Data on sleep efficiency, arousal, sleep architecture, REM sleep were compared between diagnostic and titration part of the SNPSG. Study was considered successful if patient was able to tolerate PAP during titration and also if adherent to PAP at follow up.
Results: 48 studies met the criteria for SNPSG, with 60% of SNPSG being emergency SNPSG with AHI>30. Our cohort's age ranged from 2–18 years (median age 8 years); 33 were males. Majority of the emergency SNPSG were in younger children (80% < 5 years), 75% of them continued to use PAP (mostly CPAP) until T & A with wait time being more than 3 months. Average wait time for T & A was 4 months. 25% of patients continued to use PAP following T & A as residual AHI was >10/hour. 98% of the patients were able to tolerate PAP during titration section with restoration of sleep architecture including REM with reduction in AHI, arousals and improved sleep efficiency. Bilevel PAP was used in 10% of patients in mostly planned SNPSG.
Conclusion: SNPSG can be implemented with fair degree of success during initial PSG with PAP used until T & A is performed. Planned SNPSG are also useful with residual severe OSA eliminating need for subsequent titration study. When indicated, 75% of our cohort continued to use PAP with fair adherence (>70% nightly use) following SNPSG.
Support (if any):

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OBSTRUCTIVE SLEEP APNEA AND TOTAL SLEEP DURATION IS ASSOCIATED WITH PROBLEMS WITH PHYSICAL FUNCTION MOBILITY IN CHILDREN

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Introduction: To identify the effect of Obstructive Sleep Apnea (OSA) and sleep duration on problems with health-related quality of life (HR-QoL) in children.
Methods: Children ages 8–18 years visiting sleep laboratory from 07/2019 to 01/2020 for overnight PSG participated in the study. Controls seen during 01/2020-02/2020 for issues other than sleep disturbance were recruited from the primary care pediatric clinics. HR-QoL was assessed by PROMIS V1.0 questionnaires. Statistical analysis was conducted using R 3.6.0.
Results: 122 children were studied: 64 males (52.4%).Twenty-nine(29.2%) had mild OSA, 8 (8.1%) moderate OSA, 17 (17.1%) severe OSA,46 (46.4%) were diagnosed with No-OSA and 22 (18.0%) were controls. Patients visiting the sleep laboratory had lower physical function mobility compared to controls (p=0.004). With increasing severity of OSA, there was a step wise decrease in physical function mobility (p=0.01). Correlation analysis suggested that physical function mobility was positively associated with total sleep duration (p=0.02) and negatively associated with apnea hypopnea index (p=0.01). Symptoms of anxiety in children was positively associated with number of arousals (p=0.04). Age was positively associated with fatigue (p=0.02) and negatively associated with deep sleep (p<0.001). Regression analysis confirmed that physical function mobility was associated with total sleep duration (p=0.04) and AHI (p=0.02) after controlling for age, gender and number of arousals.
Conclusion: We found interrupted sleep associated with symptoms of anxiety. OSA and reduced sleep duration are associated with problems with physical function mobility after adjusting for age, gender and number of arousals.
Support (if any): None

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SLEEP-DISORDERED BREATHING SYMPTOMS IN CHILDREN WHO CO-SLEEP: ARE CAREGIVERS BETTER REPORTERS?

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Introduction: Medical consensus advises against co-sleeping for infants to protect against SIDS, but co-sleeping in older children is often dismissed if not associated with caregiver distress. While some families may choose to co-sleep due to cultural, circumstantial, or psychosocial factors, this choice can also be due to medical concerns warranting greater caregiver attention. We aimed to explore characteristics of co-sleeping children referred for sleep disordered breathing and hypothesized that children with polysomnogram confirmed obstructive sleep apnea (OSA) would have higher caregiver-reported sleep disordered breathing symptoms as compared to children without confirmed OSA.
Methods: Caregivers who accompanied their child for polysomnogram were asked to complete a questionnaire that included sleep-related symptoms of sleep-disordered breathing (snoring, apnea, gasping/choking), restlessness, and parasomnias. Inclusion criteria are age >1.0 years and <18 years, baseline study for sleep disordered breathing, and completed questionnaire. Retrospective chart review included demographic information, BMI, co-morbid conditions, and polysomnogram results. The cohort was divided into 2 groups based on polysomnogram confirmed diagnosis of "snoring" or "OSA".
Results: Of 75 co-sleeping children, 27 (36%) had a diagnosis of snoring and 48 (64%) of OSA. The cohort was similar in age, gender, and insurance type for snoring and OSA groups (Average 5.7 +/- 2.6 yrs and 5.4 +/- 2.9 yrs, respectively; 41% and 35% female, respectively; 44% and 50% Medicaid, respectively). Notable differences in the snoring and OSA groups were found with BMI z-score (1.6 +/- 4.6 and 1.0 +/- 1.5, respectively) and absence of co-morbid conditions (44% and 63%, respectively). Regarding reported symptoms, the snoring-group compared to OSA-group had lower report of gasping/choking (19% vs 29%), bedwetting (7% vs 13%), and nightmares (7% vs 15%); and had higher report of movement (74% vs 60%), kicking (48% vs 31%), and startle/jump (30% vs 19%).
Conclusion: Although we predicted that co-sleeping would be associated with increased caregiver vigilance, witnessed sleep-disordered-breathing symptoms was only higher for report of gasping/choking and did not differ significantly for report of snoring and apnea in children with and without OSA. Interestingly, co-sleeping in children without OSA appeared to be more strongly related to report of sleep disruption in the form of restless sleep.
Support (if any):

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SLEEP DURATION IN AMERICAN CHILDREN WITH AUTISM SPECTRUM DISORDER AND THE ROLE OF PHYSICAL ACTIVITY

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Introduction: Sleep dysfunction is prevalent in autism spectrum disorder (ASD) and can have major daytime behavioral consequences. Emerging evidence suggests that physical activity may be associated with improved sleep in children, including those with ASD. We aimed to determine if there was an association between physical activity and sleep duration in American youth and if the association was consistent in children with and without ASD.

Methods: We analyzed data from children ages 6–17 years whose caregivers completed the 2018 National Survey of Children's Health (N=20,980). ASD was self-reported (N=687), and we determined if reported ASD was mild, moderate, or severe, and if reported ASD occurred with intellectual disability (ID). Participants self-reported their weekday sleep duration and days of physical activity in the past week. We classified children as sleep sufficient or insufficient based on age-specific recommendations. Logistic regression was used to determine if physical activity and ASD were associated with sleep sufficiency. Physical activity-by-ASD interaction terms were used to determine if any physical activity association was modified by ASD status. Covariates included: age, sex, race, Hispanic ethnicity, highest caregiver education level, and overweight status.

Results: Compared to children without ASD, children with ASD were 29% less likely to have sufficient sleep (OR=0.71; 95% CI: 0.52–0.99), but this association attenuated to the null after adjusting for physical activity (OR=0.77; 95% CI: 0.55–1.07). Compared to zero days, being physically active for 1–3, 4–6 or 7 days in the past week was associated with increased odds of sufficient sleep, even with adjustment for ASD status (e.g., 4–6 days: OR=1.85; 95% CI: 1.48–2.32). We did not observe a statistically significant interaction between physical activity and ASD status with respect to sleep sufficiency (P-interaction=0.571), which remained consistent when using ASD severity and ASD with ID exposure variables.

Conclusion: Physical activity was associated with increased odds of meeting age-specific sleep duration recommendations in children with and without ASD. Our observations support pursuing physical activity in future studies as a potential intervention target to improve sleep duration in children, including those with ASD.

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CLINICAL CHARACTERIZATION OF INSOMNIA DISORDER IN ADOLESCENCE

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Introduction: Insomnia is common in adolescence, particularly in older girls, with an overall prevalence comparable to major depression. Despite being associated with adverse outcomes such as an increased risk for substance dependence and suicidality, insomnia in adolescence is still under-recognized, under-diagnosed, and under-treated, and poorly described in the literature. This study aims to investigate the clinical features of insomnia in adolescence, in both boys and girls.

Methods: Eighty-five post-pubertal adolescents (16–18 years) with (N=39, 26 girls) and without (N=46, 28 girls) DSM-5 insomnia symptoms underwent a detailed clinical evaluation, including a clinical interview with a trained clinician and an extensive questionnaire battery investigating sleep behaviors, stress, coping skills, emotion regulation, mood, and personality traits.

Results: Adolescents with insomnia symptoms exhibit poorer sleep and sleep-related behaviors, such as higher insomnia severity scores, lower sleep hygiene, higher dysfunctional beliefs and attitudes about sleep, and higher pre-sleep negative thought content compared with controls ($p<0.05$). They also indicated higher stress levels associated with school performance and peer pressure, higher susceptibility to work overload and greater depressive symptoms than controls ($p<0.05$). Insomnia girls reported a lower perceived sleep quality, higher perceived stress levels, and a higher sleep vulnerability to stress than insomnia boys ($p<0.05$). Exploratory network analyses unveiled profound group differences in the extent of multi-symptoms' interconnection, with network complexity being lower in adolescents with insomnia symptoms and showing distinct symptoms' centrality and clustering.

Conclusion: Insomnia in adolescence needs to be considered in the context of both classical insomnia-related features, as well as adolescence-specific factors, such as school and peer stress. Network analysis may be a promising approach to unveil hidden relationships and patterns among insomnia symptoms and behaviors, and to better characterize insomnia, possibly advancing early recognition and treatment of the disorder.

Support (if any): National Heart, Lung and Blood Institute (NHLBI) R01HL139652 (to MdZ)

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DAILY FACILITATORS AND BARRIERS TO ADOLESCENT SLEEP: CONTRIBUTION TO ACTUAL SLEEP OVER 28-DAYS OF SCHOOL AND VACATION.

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Introduction: Little is known about what adolescents perceive as helping (facilitators) or preventing (barriers) them from getting sufficient and good quality sleep, and how these factors contribute to their actual sleep.

Methods: 205 (54.2% female, 64.4% non-white) Year 10–12 adolescents (Mage = 16.9 ± 0.9) completed daily morning surveys, and their sleep was measured via actigraphy over 2 school-weeks and 2 subsequent vacation-weeks. Morning surveys assessed self-reported sleep and the usage of 8 facilitators and 6 barriers of sleep from the previous night. Linear mixed-effects models were used to examine contributions of facilitators/barriers to actigraphy and self-reported total sleep time (TST) and sleep onset latency (SOL), controlling for age, sex, race, place of birth, and study day, separately for school and non-school days.

Results: On average, adolescents reported using 3.7 facilitators and encountering 1.5 barriers daily. Compared to school, non-school days were characterised by more frequent use of facilitators and more barriers encountered. Overall, facilitators or barriers explained an additional 1–7% (p-values < .01) of variance beyond the covariates. Similar facilitators and barriers contributed to actigraphy and self-reported TST and SOL, however, self-reported sleep variables were more affected. Notable facilitators that predicted longer TST and

shorter SOL were: "follow body cues", "avoid activities interfering with sleep", "create good sleep environment", "plan bedtime and go to bed as planned" (only TST on school days), and "manage thoughts and emotions" (only SOL). Notable barriers that predicted shorter TST and longer SOL were: "pre-bedtime thoughts and emotions", "inconsistent routines", "unconducive sleep environment", "activities interfering with sleep" (only non-school) and "other household members' activities" (only SOL).
Conclusion: This intense longitudinal study showed that on a daily basis, adolescents perceive a range of factors as facilitating and preventing sufficient and good quality sleep. These factors are predictive of their actual sleep duration and onset latency and need further research to understand their functions and clinical implications.
Support (if any):

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SLEEP ATTITUDES AND BELIEFS IN CHILDREN WITH JUVENILE IDIOPATHIC ARTHRITIS AND THEIR CAREGIVERS

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Introduction: Sleep deficiency is highly comorbid in children with juvenile idiopathic arthritis (JIA), affecting approximately 40% of children. In this study, we examined children's and parents' beliefs and attitudes about sleep, their self-efficacy, and self-regulation in sleep-related behaviors and managing JIA, and if these factors were associated with their self-report and actigraphic sleep patterns.
Methods: The sample included 44 children with JIA (22 girls; mean age 10.5±1.8) and their parents. Dyads completed the Dysfunctional Beliefs and Attitudes about Sleep Scale and Self-Efficacy Scale. Children completed the Index of self-regulation. Parents completed the Pittsburgh Sleep Quality Index and PROMIS sleep-disturbance. Children wore an actiwatch and completed electronic sleep diaries for ten days. Scored actigraphy variables included children's total sleep time (TST), wake time after sleep onset (WASO), sleep efficiency (SE, %); sleep diaries included the variables of children's time in bed (TIB). Parents' self-reported variables included sleep-disturbances and sleep quality (SQ).
Results: Children's mean TST was 7.7 hours (±0.7), mean SE of 77%, and mean WASO of 1.1 hours (±0.4). After adjusting for child sex and age, children's beliefs and attitudes towards sleep (BAS) were positively correlated with their self-efficacy in carrying out sleep-related behaviors ($r=.6$, $p<.0001$). Parents' BAS were positively correlated with child self-efficacy in sleep ($r=.4$, $p<.05$) and TIB ($r=.4$, $p<.001$). Children's self-regulation was positively correlated with parents' SQ ($r=.4$, $p<.05$). In the first regression model, parents' self-efficacy in managing their child's JIA and parents' sleep disturbances explained 25% of the variance of children's TST, ($F(4,35)=2.8$, $p=.039$). Both parents' self-efficacy and sleep disturbances were significant predictors of children's TST. In the second regression model, children's self-regulation, self-efficacy, and parents' sleep disturbances explained 32% of the variance of parents' self-reported SQ, ($F(3,39)= 6.12$, $p=.002$).
Conclusion: The findings suggest that self-efficacy, self-regulation, BAS in both children and parents were associated with better sleep health. Interventions that incorporate parent-child shared decision making about sleep-related knowledge, motivation, skills for setting/achieving goals, and problem-solving strategies are needed for families with children with JIA and sleep deficiency.
Support (if any): This work was supported by the NIH/ /NINR (P30NR016585, R21NR01747).

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CHILD SLEEP ONSET LATENCY MEDIATES PARENTAL DEPRESSION AND NON-COMPLIANCE IN CHILDREN WITH AUTISM SPECTRUM DISORDER

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Introduction: Parents who have been diagnosed with depression often report that their children are not compliant and have difficulty falling asleep. Parents with depression are less likely to be consistent or enforce bedtimes resulting in the child having less bedtime rules and getting less sleep. Overtime this may mean the child develops poor sleep habits and difficulty falling asleep. Although these relationships have yet to be studied in children with Autism Spectrum Disorder (ASD), it is an important area given the high prevalence of children with ASD who have sleep difficulties. The current study examined whether parent-reported child sleep onset latency mediated the relationship between parental depression and child non-compliance.
Methods: The sample (N=50) consisted of parents (81% female) reporting on their children aged 6–12 (M=8.63, SD = 2.00; 76% male). All children were diagnosed with ASD and had parent reported sleep complaints. Children and their parents were recruited because they expressed interest in a behavioral treatment sleep study and these data come from the baseline data collection associated with that study. Measures included sleep onset latency on the Child Sleep Health Questionnaire (CSHQ), an item on the Pediatric Symptom Checklist (PSC) which asked if a child follows rules, and a question asking if the parent had been diagnosed with depression.
Results: Analyses were conducting using AMOS 27.0. Slightly less than half (45%) of parents reported having been diagnosed with depression. Parent-reported child sleep onset latency significantly mediated (β =.13) the relation between parental depression and non-compliance. Parents who had been diagnosed with depression were associated with greater child sleep onset latency (β =.32, p = .04) and greater child sleep onset latency was associated with greater non-compliance (β =.40, p = .01). The direct effect between parental depression and non-compliance was not significant.
Conclusion: These results suggest that difficulty falling asleep may help to explain why children of parents who have depression are not compliant. Future research should utilize longitudinal and experimental methodology to determine the causality of these relationships.
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PSYCHOSOCIAL FUNCTIONING MEDIATES PARENTAL DEPRESSION AND SLEEP BEHAVIORS IN CHILDREN WITH AUTISM SPECTRUM DISORDER

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Introduction: Parents who have been diagnosed with depression often report that their children have poor sleep behaviors. This relationship may occur because the children of parents with depression are more likely experience poor psychosocial functioning, which can

negatively impact their sleep. Children with Autism Spectrum Disorder (ASD) are particularly at risk for sleep difficulties, and it is important to better understand these relationships as scant to no research has been done which investigates parental depression, child psychosocial functioning, and child sleep among children with ASD. The current study examined whether parental perception of their child's psychosocial functioning mediated the relationship between parental depression and their child's sleep behaviors.

Methods: The sample (N=36) consisted of parents (81% female) reporting on their children aged 6–12 (M=8.56, SD = 1.86; 75% male). All children were diagnosed with ASD and had sleep complaints as reported by their parents. Children and their parents were recruited because they expressed interest in a behavioral treatment sleep study and these data come from the baseline data collection associated with that study. Measures included Sleep Behaviors factor from the Child Sleep Health Questionnaire (CSHQ), the Pediatric Symptom Checklist (PSC), and a question asking if the parent had been diagnosed with depression.

Results: Analyses were conducting using AMOS 27.0. Child psychosocial functioning significantly mediated (β = .12) the relation between parental depression and child sleep behavior. Parents who had been diagnosed with depression were more likely to report greater child psychosocial difficulties (β =.39, p = .01) and child psychosocial difficulties were associated with a greater likelihood of the child having worse sleep behavior (β =.32, p = .04). The direct effect between parental depression and child sleep behavior was not significant.

Conclusion: These results indicate that child psychosocial functioning may help to explain the connection between diagnosed parental depression and poor child sleep behavior among children with ASD. This suggests that psychosocial functioning may be an important aspect to target in sleep interventions, particularly for children with ASD.

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IMPACT OF WEIGHT ON INSOMNIA SEVERITY, SLEEP QUALITY, AND INSOMNIA IMPROVEMENT IN A CLINICALLY REFERRED PEDIATRIC SAMPLE

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Introduction: Children with overweight/obesity are more likely to have shortened sleep, though little is known about the role of weight status in insomnia severity, sleep quality, and sleep hygiene in clinically referred youth.

Methods: A total of 1133 children (43.7% female) presented to a Pediatric Behavioral Sleep Medicine Clinic for insomnia. At the initial evaluation, caregivers of children ages 2–10.9 years (N = 744) completed the Pediatric Insomnia Severity Scale (PISI) and the Children's Sleep Habits Questionnaire (CSHQ); adolescents ages 11–18 years (N = 389) completed the PISI, the Adolescent Sleep Hygiene Scale (ASHS), and the Adolescent Sleep Wake Scale (ASWS). The PISI was completed during at least one Pediatric Behavioral Sleep Medicine visit subsequent to evaluation and initiation of treatment. Patient height and weight, objectively measured within 3 months of the initial evaluation, was used to determine sex-adjusted body mass index z-scores (BMIz). Hierarchal linear regression models were used to determine the impact of BMIz on baseline PISI insomnia severity scores, and CSHQ, ASHS, and ASWS total scores, after covarying for income. Repeated-measures general linear modeling was used to determine whether weight status moderated improvement in insomnia severity over time, covarying for income.

Results: For children (ages 2–10.9), weight was not associated with baseline insomnia severity (p=.62) or predictive of insomnia improvement following behavioral sleep medicine intervention (p=.71), though higher weight predicted poorer parent-reported sleep quality (p=.006). For adolescents (ages 11–18), higher weight was predictive of higher baseline insomnia severity (p=.026), though did not predict insomnia improvement over time (p = .86); higher weight was also predictive of poorer sleep hygiene (p<.001) and worse sleep quality (p=.03).

Conclusion: Initial insomnia severity and subjective sleep quality may be worse for youth of higher weight, particularly for adolescents; these findings increase our understanding of how and when overweight/obesity negatively impacts sleep. Fortunately, youth with higher weight respond equally well to pediatric behavioral sleep medicine interventions as their lower-weight peers, suggesting that these interventions need not be modified based on patient weight.

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INSOMNIA-RELATED COGNITIVE AND BEHAVIOURAL FACTORS IN ADOLESCENTS WITH DELAYED SLEEP-WAKE PHASE DISORDER

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Introduction: Although delayed sleep-wake phase disorder (DSWPD) shares phenomenological experiences with chronic insomnia disorder, previous research on the conceptual understanding of DSWPD has been limited, with a predominant focus on its chronobiological basis. The present study examined several insomnia-related cognitive and behavioural factors in adolescents with DSWPD.

Methods: Twenty-five adolescents with DSWPD (age = 19.9 ± 1.6; female = 28%), 28 with chronic insomnia disorder (age = 20.4 ± 2.0; female = 61%), diagnosed according to the ICSD-3 criteria, and 25 healthy control (age = 20.4 ± 1.5; female = 68%) were included in the present study. Participants completed 7-day prospective sleep diary and actigraphy monitoring, and a battery of questionnaires on sleep and chronotype measures. Participants were also measured on hyperarousal (Pre-Sleep Arousal Scale, PSAS), sleep reactivity (Ford Insomnia Response to Stress Test, FIRST), sleep-related beliefs (Dysfunctional Beliefs and Attitudes about Sleep, DBAS-16), and sleep hygiene practices (Sleep Hygiene Practices Scale, SHPS). Analysis of covariance (ANCOVA) with gender as the covariate was used for between-group comparisons.

Results: Relative to healthy control group, insomnia and DSWPD group showed significantly more insomnia symptoms as measured by Insomnia Severity Index (p<.001). As compared to healthy control group, DSWPD group showed significantly more delay in circadian phase based on sleep diary and actigraphy derived mid-point of sleep, as well as greater preference towards eveningness as measured by the Morningness-Eveningness Questionnaire. DSWPD group

also showed significantly more cognitive and somatic hyperarousal (p<.001, d = 1.36–2.31), sleep reactivity (p<.001, d = 1.73), dysfunctional belief about sleep (p<.001, d = 1.59), as well as poorer sleep hygiene practices (p<.001, d = 2.62), compared to healthy control. There were no significant differences in the circadian parameters, PSAS, FIRST, DBAS-16, and SHPS between DSWPD and insomnia groups.

Conclusion: Several insomnia-related cognitive and behavioural factors, namely hyperarousal, sleep reactivity, maladaptive beliefs about sleep, and poor sleep hygiene, are also evident in youths with DSWPD. The findings had important implications for the conceptual understanding and clinical management of DSWPD.

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TREATING INSOMNIA IN YOUTH DEPRESSION: A RANDOMIZED CONTROLLED TRIAL OF CBT FOR DEPRESSION VS. CBT FOR INSOMNIA

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Introduction: Insomnia is often comorbid with depression in youths and both may reciprocally exacerbate clinical outcomes and lead to a constellation of detrimental consequences. The present study aimed to test the efficacy of cognitive behavioral therapy (CBT) for insomnia (CBT-I) and CBT for depression (CBT-D), when compared with waitlist control, in youths with comorbid insomnia and depression.

Methods: 112 participants aged 12–24 years old (67.9% female) with insomnia and depression according to DSM-5 diagnostic criteria were randomised to one of the following conditions: 8-week group CBT-I (n=33), 8-week group CBT-D (n=39), or waiting-list control (n=40). Insomnia (Insomnia Severity Index, ISI) and depressive symptoms (Hamilton Rating Scale for Depression, HAMD) were assessed at baseline and post-intervention. The two active treatment groups were additionally followed up at post-treatment one-month.

Results: Linear mixed model showed that both treatment groups (CBT-D: Cohen's d = -0.44, p<.001; CBT-I: Cohen's d =-0.56, p<.001) had significantly lower ISI scores at post-intervention follow-up, as compared to the waitlist group. There was a significant difference in clinically meaningful improvement in insomnia (a reduction of ISI score ≥ 6 from baseline to post-intervention follow-up) between the groups (CBT-I: 73.1%; CBT-D: 40.0%; WL: 28.6%; p=.002). Moreover, there was a significant difference in remission of depression (HAMD≤7) at post-intervention follow-up (CBT-D: 75.9%; CBT-I: 81.5%; WL: 22.9%) (p <.001). Both CBT-D and CBT-I resulted in comparable improvements in insomnia and depressive symptoms at one-month follow-up (p>.05).

Conclusion: Preliminary evidence from this study supports the efficacy of CBT-I for improving both sleep and mood in youths with comorbid insomnia and depression.

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RESPONSE TO INTRAVENOUS FERRIC CARBOXYMALTOSE IN THE TREATMENT OF CHILDHOOD RESTLESS LEGS SYNDROME/PERIODIC LIMB MOVEMENT DISORDER

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Introduction: Pediatric Restless Legs Syndrome (RLS)/Periodic Limb Movement Disorder (PLMD) are treatable disorders affecting quality of life. The first line therapy is oral iron, which may have gastrointestinal side effects or suboptimal absorption. Consequently, parenteral iron preparations are needed, but have been insufficiently studied in children. This study evaluates the response to intravenous ferric carboxymaltose (FCM) in pediatric RLS/PLMD.

Methods: We performed a retrospective chart review of children who received FCM between May 2018 and January 2019 for treating RLS/PLMD. Serum ferritin before and after the infusion were compared. Where possible, the Clinical Global Impressions of Improvement (CGI-I) was evaluated. Side effects documented in the charts were extracted. The median administered dose of FCM was 10.1 mg/kg (range 9.6–20.8) over 0.6 to2 hours.

Results: There were 27 patients, with mean age of 10.0 +/-4.2 years. 52% were female. 24 had RLS and 3 had PLMD. 20/27 (69.7%) had prior oral iron therapy; 4/20 (26.0%) experienced side effects. Adverse events from FCM infusion included procedure-related anxiety in 4/27, nausea in 1/27, infusion site pain in 2/27, and tachycardia in 1/27. One patient developed subcutaneous extravasation of iron with brownish skin discoloration and a resulting adjustment disorder. Three patients had phosphorus checked following infusion; all were normal. Serum ferritin was available both before and after the infusion for 17 patients. Mean serum ferritin prior to infusion was 27.2 +/-15.7 µg/L (range 6–58) and after the infusion it was 109.8 +/-49.34 µg/L (range 27–192). Mean ferritin increase was 82.6 +/-41.5 µg/L (range 14–160; p=0.0001). Post-infusion ferritin was over 50 µg/L for all but 2 of the subjects, with follow up ranging from 31–266 days (mean 120 days). A larger increase was seen at higher doses (p=0.01). Ferritin increase was not impacted by age, gender, symptom severity, PLMI or prior ferritin level. CGI-I was applied to 15 patients with sufficient follow-up documentation and showed improvement in 86%, with 79% much or very much improved.

Conclusion: The administration of FCM in children with RLS/PLMD is associated with a satisfactory rise in serum ferritin and modest symptomatic improvement.

Support (if any):

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THE RELATIONSHIP BETWEEN NAPPING AND BEHAVIORAL PROBLEMS AMONG VOCATIONAL HIGH SCHOOL STUDENTS IN CHINA

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Introduction: Although napping is very common and related to the outcome of individual development, the relationship between napping and health is not the same in different social and cultural contexts. In China, napping is considered as a healthy lifestyle and is often associated with better adolescent development outcomes. As a special group of teenagers (the academic level does not meet the requirements of ordinary high school), vocational high school students have a higher incidence of behavioral problems than ordinary high school students. Therefore, the purpose of this study is to explore the characteristics of napping and its relationship with behavioral problems in vocational high school students.
Methods: The napping questionnaire, Youth Self Report (YSR), general information questionnaire and other tools for covariates were used to measure 2505 high school students (62.04% boys, 37.96% girls, 16.71±0.02 years), recruited by convenient sampling. The relationship between nappingand behavioral problems was analyzed by multiple linear regression.
Results: 72.58% of the participants reported taking a midday nap at least three days per week during the past month, and 55.79% of our sample reported naps more than 30 minutes. Multiple regression analysis showed that nap frequency was negatively associated with high school students' behavior problems after controlling for general characteristics and other important covariates. Compared with high school students who did not nap or napped less than 1 time/week, high school students who napped 1–2 times/week or 3–4 times/week had lower level of both internalizing behavior problems and externalizing behavior problems. There was no statistically significant association between nap duration and behavior problems.
Conclusion: This study finds that when napping is allowed, moderate frequency of napping is associated with lower level of internalizing and externalizing behavioral problems in vocational high school students, while nap duration is not significantly associated with behavioral problems. Further research is needed to explore the mechanism of the relationship between napping and behavior problems.
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LARGE BODY MOVEMENTS ON VIDEO-POLYSOMNOGRAPHY ARE ASSOCIATED WITH DAYTIME DYSFUNCTION IN CHILDREN WITH RESTLESS SLEEP DISORDER

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Introduction: Restless sleep disorder (RSD) is a recently described disorder of children and adolescents with complaints of restless sleep and is characterized by large body movements which interfere with nocturnal sleep, are associated with daytime dysfunction, and are not better explained by another disorder (1, 2). Polysomnography criteria for RSD includes the scoring of large body movements (LBMI) and identified an LBMI ≥ 5 as sensitive and specific for RSD. As data is currently limited to two pediatric centers, our study aims to identify RSD cases at our institution, characterize their PSG, and determine their effect on daytime dysfunction and quality of life.
Methods: This single center retrospective study included 41 children with complaints of restless sleep and 35 sex- and age-matched children with RLS/PLMD collected from February 2018 to November 2020. The video PSGs were re-scored utilizing the previously published criteria (1,3). We used two LBMI thresholds, LBMI ≥ 5 and an exploratory LBMI ≥ 4. We then compared Epworth Sleepiness Scores (ESS), Pediatric Quality of Life measures (PedsQL), PSG characteristics, LBM associated awakenings and ferritin level between groups.
Results: Twenty-one children (mean age=8.3 ± 3.13 SD) met the LBMI>=4 criteria, of which 11 (age=8.4±3.81 SD) met the LBMI>=5 criteria. All three groups reported decreased quality of life (PedsQL total LBMI>=4=66.21±20.28, LBMI>=5=72.39±18.24, RLS/PLMD=55.54±19.86), low mean ferritin values (LBMI>=4=33.18 ± 20.11, LBMI>=5 =28.38 ± 12.68, RLS/PLMD = 36.57±25.46), and increased wake after sleep onset (WASO) (LBMI>=4 = 42.82 ± 34.26, LBMI>=5=44.38 ± 38.4, RLS/PLMD = 52.34 ± 42.03), with no significant differences between groups. Both LBMI>=4 and LBMI>=5 groups exhibited higher ESS compared to the RLS/PLMD group (LBMI>=4=10.36±7.13; LBMI>=5=11.13±5.19; RLS/PLMD=6.17±4.04; LBMI>=4 vs RLS/PLMD, P=0.05; LBMI>=5 vs RLS/PLMD, P = 0.032). Both awakenings and WASO associated with LBM were high in LBMI>=4 and LBMI>=5 (Awakenings: LBMI>=4=8.43±9.96,LBMI>=5=8.00±12.19,WASOassociatedLBM: LBMI>=4=23.60±44.64 LBMI>=5=29.46±57.57)
Conclusion: One quarter of children with complaints of restless sleep met the standard criteria for RSD. Both children with RSD (including the exploratory LBMI≥ 4 group) and RLS/PLMD had increased WASO, low ferritin and decreased quality of life, but the RSD group had more daytime sleepiness compared to RLS/PLMD.
Support (if any):

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TEMPORAL DAILY RELATIONSHIPS BETWEEN SLEEP DEFICIENCY AND PAIN IN YOUTH WITH SYSTEMIC LUPUS ERYTHEMATOSUS

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Introduction: Systemic Lupus Erythematosus (SLE) is a chronic, inflammatory autoimmune disorder characterized by recurrent episodes of pain and is more prevalent in youth of color. Although sleep deficiency (poor quality and an inadequate amount of sleep) and pain are interrelated, most of what is known about SLE pain and sleep rely on reports from adults. Less is known about these associations in youth with SLE, leaving a critical gap in care for this population. This study aims to describe the temporal daily relationships between sleep deficiency and pain in 11-to 18-year-old youth with SLE.
Methods: Twenty-three youth (n=21 girls, n=9 Hispanic) with SLE (mean age=14.7 □ 2.2) participated in the study. Youth wore actigraphy and completed electronic sleep diaries for consecutive 10 days. Actigraphic sleep variables (Total Sleep Time [TST], Sleep Efficiency [SE]) and self-reported Sleep Quality (diary SQ) were examined as predictors of next-day pain in the morning. Average daytime pain was examined as a predictor of nighttime sleep (both actigraphic and self-reported sleep variables). Pubertal stage and ethnicity (Hispanic vs. Non-Hispanic) were entered as covariates in all models.
Results: Of the sample, the mean TST was 7 □ 1.2 hours and the mean SE was 73.5 □ 9.2% as measured by actigraphy. On average, diary SQ negatively predicted next-day pain in the morning ($p < .001$). On average, pain negatively predicted TST ($p < .05$) and diary SQ (p

<.001). The within-subject relationships between sleep and next-day pain were not significant. Daytime pain predicted neither actigraphic nor self-reported sleep quality.
Conclusion: Poor sleep is a modifiable behavior, and improving sleep quality may reduce pain intensity in youth with SLE. Although further study is needed, the findings suggest that sleep is a potential target for interventions to alleviate symptoms of pain in this population.
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WAKE UP AND LEARN: A SCHOOL BASED SLEEP EDUCATION AND SURVEILLANCE PROGRAM

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Introduction: Insufficient sleep, especially for students, has been a hot topic in news for the past few years. However, despite this increase in media attention, the number of adolescents with unrecognized sleep difficulties continues to grow. A partnership between Janet Weis Children's Hospital (Geisinger) and Montgomery School District was established to pilot a program called "Wake Up and Learn" (WUAL). WUAL is a population based preventative sleep screening and education program for 7th to 12th graders through an asynchronous virtual platform. This is a descriptive summary of implementation of WUAL and early phase results.
Methods: The WUAL team consists of a board-certified pediatric sleep specialist, school guidance counselor and 2 project managers. The Protection of Pupil Rights Amendment (PPRA) was considered. A letter describing the program with an opt-out option was provided. WUAL website was developed to serve as an educational resource and to access the surveys. The surveys were generated using REDcap and included the Epworth sleepiness scale -CHAD (ESS) and the childhood sleep habits questionnaire (CHSQ). The surveys became available online and the students were instructed access the website and complete the surveys as part of class time.
Results: A total of 289 surveys were accessed, 287 ESS (99%) and 281 CSHQ (97%) were completed. Pathologic ESS scores (> 9), suggesting excessive daytime sleepiness (EDS), was identified in 75 students (26%). Scores suggestive of sleep dysfunction (> 41) on the CSHQ was found in 184 students (65%). Out of the 184 students 64 students also had an abnormal ESS.
Conclusion: This method of screening has demonstrated a high degree of successful completion. Based on early data, sleep pathology may be more prevalent than typically reported in children (20–25%). EDS was common, present in a quarter of students. However, of 184 students with abnormal CHSQ only 35% also had EDS. This suggests that there may be a need to identify alternative daytime dysfunction, such as school performance or mental health symptoms. This is an ongoing program that will have further updates and plans for expansion to more school districts.
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SLEEP FEATURES LONGITUDINALLY ASSOCIATED WITH REFRACTIVE ERRORS IN PRESCHOOLERS

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Introduction: Refractive errors are very common, in particular in children and adolescents, leading to global health issues, academic implications and economic costs. The process of emmetropization in child development is a multifactorial and active mechanism, and is yet to be fully understood. Light exposure and endogenous circadian rhythmicity are thought to have an important role in this process. They are also known to be both cause and consequence of various sleep habits. The study aims at investigating the role of sleep duration and timing in refractive error development of preschoolers.
Methods: Sleep duration and timing were assessed at age 2 and 5 years, and vision problems at age 5 through parental auto-questionnaires in 1,130 children from the EDEN birth-cohort. We performed both cross-sectional and longitudinal analyses using logistic regression models, before and after adjusting for age, sex, socio-economic status, nap duration, time spent outdoors and daily screen-time. We conducted multiple imputations to deal with missing data on covariates. The shape of the association was considered by splitting sleep duration into tertiles.
Results: At age 5 years, 20.4% of the children were prescribed glasses (2% for myopia, 11.9% for hyperopia and 6.8% for unknow reason). Children slept on average (SD) 11h05 (30 min) per night at age 2 and 10h49 (48 min) at age 5. Average bedtime and midsleep were 8.36 pm (30 min), 2.06 am (36 min), and 8.54 pm (30 min), 2.06 am (24 min) at age 2 and 5, respectively. In the raw longitudinal analysis, a U-shaped association was observed between nocturnal sleep duration at age 2 and eyeglass prescription at age 5: 2-years-old children sleeping 11h30 had a higher risk to have an eyeglass prescription by the age of 5. Later midsleep and bedtime at age 2 were associated with an increased risk of eyeglass prescription at age 5. All associations, except the one concerning bedtime, were barely changed after adjustment while becoming borderline significant.
Conclusion: Duration and timing of sleep at age 2 were associated with subsequent onset of refractive errors in preschoolers from a general population. Sleep and light hygiene might be targets for prevention.
Support (if any):

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NEIGHBORHOOD SAFETY AND SLEEP DURING CHILDHOOD

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Introduction: Neighborhood safety has been associated with sleep health among adults; however, few studies have investigated its association with sleep characteristics during childhood.
Methods: Using data from 1,693 Black/African-American women enrolled in the Study of Environment, Lifestyle and Fibroids from 2010 to 2012, we investigated associations between neighborhood safety and sleep at age 5 years. Participants, aged 23–35 years, reported childhood neighborhood safety (unsafe, somewhat safe, very safe) and light sleep (yes/no). Participants, with assistance from their mothers or others, provided information on participants' frequency of good sleep hygiene as a child (i.e., to bed by 8 p.m. in a quiet, dark room) as always/most of the time, sometimes, or rarely/never. Adjusting for relative childhood household income and both mother's and father's age at participant's birth, we used Poisson regression with robust variance to estimate prevalence ratios (PRs) and 95% confidence intervals (CIs) to compare sleep characteristics for participants who reported unsafe vs. very safe neighborhoods.

Results: While 20% of participants reported living in an unsafe neighborhood, 41% reported a somewhat safe neighborhood and 39% reported a very safe neighborhood at age 5 years. The unadjusted prevalence of always/most of the time going to bed by 8 p.m. in a quiet, dark room was highest among participants who reported very safe neighborhoods. After adjustment, participants in unsafe neighborhoods were substantially more likely than those in very safe neighborhoods to only sometimes (vs. always/most of the time) go to bed: by 8 p.m. (PR=1.57 [95% CI:1.21–2.03]), in a quiet room (PR=2.11 [1.43–3.11]), and in dark room (PR=1.44 [1.09–1.90]). Patterns were similar for frequencies of rarely/never and often practicing good sleep hygiene. Light sleep was not associated with neighborhood safety.
Conclusion: Perceived neighborhood safety was associated with multiple sleep dimensions in childhood.
Support (if any):

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SLEEP DISTURBANCES AND EXECUTIVE FUNCTION OUTCOMES AFTER CRITICAL CARE HOSPITALIZATION IN CHILDREN WITH ACQUIRED BRAIN INJURY

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Introduction: Annually, over 60,000 children require critical care admission for acquired brain injury (ABI) in the US, and many face long-term cognitive morbidity. Over 50% of these children also develop sleep/wake disturbances (SWD). Given the importance of sleep to brain development and healing after injury, we hypothesized SWD in children after ABI would portend worse cognitive outcomes in domains of executive function.
Methods: We performed a prospective observational study of N=80 children aged 6–18 years with ABI evaluated 1–3 months after critical care hospitalization. SWD were evaluated using the Sleep Disturbances Scale for Children (SDSC). The primary outcome was the Behavior Rating Inventory of Executive Function, 2nd Edition (BRIEF-2) Global Executive Composite (GEC; an age and gender adjusted T-score). Secondary cognitive outcomes included age adjusted scaled scores (ss) from the Delis Kaplan Executive Function System (DKEFS), Wechsler Intelligence Scale for Children, 5th Edition (WISC-V), and Children's Memory Scale (CMS). Relationships between the SDSC and cognitive measures were evaluated using Spearman correlation (rs). Multiple linear regression evaluated associations between SWD and GEC T-scores controlling for patient and ABI characteristics.
Results: Sixty-five (81%) eligible children completed evaluation, and 48% had clinically significant SWD (total SDSC ≥39). Significant correlation ($p<0.05$) was found between the SDSC total score and worse GEC T-score (rs=0.60), and worse ss for CMS numbers forward (rs=-0.39), WISC-V coding (rs=-0.36), DKEFS number letter switching total time (rs=-0.38), and DKEFS category fluency (rs=-0.43). Presence of SWD was significantly associated with a full standard deviation worsening in the GEC T-score (β-coefficient= 10.2, 95% Confidence Interval=1.0–19.3) when controlling for age, race, gender, admission Glasgow Coma Scale, critical care intervention, and chronic comorbidities.
Conclusion: Children with ABI requiring critical care have high rates of SWD after discharge that are associated with significantly worse executive function outcomes in overall function (BRIEF-2 GEC) and direct objective assessments (DKEFS, WISC-V, CMS) evaluating aspects of executive functioning including attention, processing speed, cognitive flexibility, and working memory. SWD may serve as a modifiable target to improve cognitive outcomes in this vulnerable pediatric population.
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OBJECTIVE VS. SUBJECTIVE SLEEP DATA IN EARLY CHILDHOOD: IMPLICATIONS FOR HEALTH DISPARITIES RESEARCH

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Introduction: Given limited psychometric research with families of lower socioeconomic status (SES) and/or non-White backgrounds, this study explored the feasibility of and discrepancies between actigraphy and maternal-reported nightly child sleep in preschoolers of lower-SES and primarily Black backgrounds.
Methods: Twenty-seven children (Mage=3.3 years, SD = 1.2 years; 59.3% girls; 85.2% Black; 100% family income <125% of the US poverty level) were asked to wear an actigraph for 14 days while mothers completed telephone-based sleep diaries. Bedtime, wake time, nighttime sleep duration, nap duration, and 24-hour sleep duration were collected by both measures. Paired t-tests examined actigraphic versus mother-reported child sleep.
Results: Twenty-six percent of dyads (n=7) were excluded due to insufficient data (1-hour difference between measures on >50% of nights). There were no significant demographic differences between dyads with and without discrepant data. Diary-derived sleep onset was calculated by adding caregiver-reported bedtime and caregiver-reported sleep onset latency. There was no significant difference between actigraphy-derived sleep onset (M=10:20PM, SD=69min) and diary-derived sleep onset (M=9:59PM, SD=51min). Average actigraphy sleep offset (M=7:27 AM, SD=62 min) was 42 minutes earlier than diary-derived wake time (M=8:09 AM, SD=84 min), $p<.05$. Actigraphy-estimated nighttime (M=8.38 hours, SD=.80) and 24-hour sleep duration (M=9.31 hours, SD=1.13) were 0.92 and 0.85 hours shorter, respectively, than diary-derived nighttime (M=9.30 hours, SD=1.07) and total sleep duration (M=10.16 hours, SD=1.17), $p<.005$. There were no significant differences in average nap duration. The primary mother-reported barrier in completing diaries was limited awareness of child sleep due to work schedules.
Conclusion: Study results highlight some of the challenges of collecting and scoring actigraphy and diary data in preschoolers of lower-income backgrounds, in particular missing diary data and discrepancies between actigraphy and diaries. These findings suggest a need to incorporate both subjective parental report and objective measurement of child sleep in clinical and research contexts, as well determine ways to enhance feasibility and scoring procedures.
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ODDS OF RECEIVING SLEEP DIAGNOSES IN COMMON PEDIATRIC CHRONIC MEDICAL CONDITIONS

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Introduction: Sleep disorders (SD) are under-diagnosed in the general pediatric population. Children with chronic medical conditions (CMC) tend to have a higher prevalence rate of SD; however, the

studies about the rates of diagnosis of SD are limited. We examined the odds of receiving SD diagnoses in children with various CMC and hypothesized that if this likelihood is established, screening tools can be developed to increase the rates of diagnoses and improve clinical outcomes.

Methods: Chi-square test and regression analysis were used to test the association between SD and CMC based on ICD-9 and -10 diagnosis codes retrieved from the Medicaid claims submitted for children (0 to 18 years) enrolled in the Centers for Medicare and Medicaid Services-funded Coordinated Health Care for Complex Kids (CHECK) project, at an urban, public tertiary care hospital. Children without a CMC were excluded.

Results: Among 16,609 children with CMC (mean [SD] age of 9.1 [5.3] years; 56.4% male; 77% with multiple CMC), 14.1% received a diagnosis of SD. Compared to the cohort without a particular CMC, children with attention deficit hyperactivity disorder (ADHD), obesity, developmental disorder, or asthma had following odds of receiving sleep diagnosis respectively (odds ratio (OR) [Confidence Interval]): insomnia (6.9 [5–9.5]; 2.4 [1.7–3.2]; 1.6 [1.2–2.3]; 0.7 [0.5–1]), circadian rhythm disorders (6.1[2.7–13.7]; 2.8 [1.3–2.6]; 3.0 [1.4–6.4]; 0.5* [0.2–1.1]), hypersomnia (2.9 [1.0–8.6]; 7.8 [3–20.2], 0.9* [0.3–2.6], 0.8* [0.3–2.2]), and sleep-related movement disorder (1.9* [0.9–4.3]; 4.4 [2.5–7.8]; 2.2 [1.2–3.9]; 0.6*[0.3–1.1]). (*=p value <0.05).

Conclusion: Odds of receiving sleep diagnoses vary across CMC. Among others, strong associations between obesity-hypersomnia and ADHD-insomnia were noted. This information may help clinicians implement appropriate screening interventions to improve early SD detection and management. Further studies to examine these associations are necessary.

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SLEEP TRAJECTORIES BETWEEN THE AGE OF 2 AND 5 ARE ASSOCIATED WITH BLOOD CYTOKINE LEVELS AT AGE 5 IN THE EDEN BIRTH-COHORT STUDY

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Introduction: There is a reciprocal interaction between sleep and the immune system. Activation of the immune system changes the quality of sleep, and sleep regulates innate and adaptive immune responses. While these interactions have been studied in adults and adolescents, only a few studies have focused on school age children and none on preschoolers. Here, we have studied the association between night sleep trajectories between the age of 2 and 5 and serum levels of four cytokines in 5-year-old children.

Methods: A total of 687 children (44% girls) from the EDEN French birth cohort were included. Information on night sleep trajectories between 2 and 5 was available in all included individuals, as well as the levels of Tumor necrosis factor-alpha (TNF-alpha), interleukin (IL)-6, interferon gamma (IFN-gamma), and IL-10 in 5-year-old children. The associations between sleep trajectories and cytokines were assessed by multivariate linear regressions adjusted for socioeconomic, familial, maternal, perinatal and child factors.

Results: A shorter sleep duration trajectory (<10h/night, 4.5% of children) was associated with higher levels of IL-6 when compared to the reference trajectory (≈11h30/night, 37.4% of children). A longer sleep duration trajectory (≥11h3/night, 40.9% of children) was associated with higher levels of IL-10. A changing sleep duration trajectory (≥11h30/night followed by 10h30/night, 5.6% of children) was associated with increased levels of TNF-alpha. No statically significant association was observed between sleep duration trajectories and IFN-gamma.

Conclusion: This first longitudinal study in preschoolers demonstrates an association between sleep duration trajectories and blood levels of IL-6, IL-10 and TNF-alpha. While association does not imply causation, our results are compatible with an impact of sleep duration on low-grade inflammation in preschool children. Should our results be replicated in an independent study sample, it would pave the way for a better understanding of the interactions between sleep and the immune system.

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THE ASSOCIATIONS BETWEEN EXCESSIVE DAYTIME SLEEPINESS AND EMOTIONAL LABILITY IN TYPICALLY DEVELOPING ADOLESCENTS

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Introduction: Excessive daytime sleepiness (EDS), defined as a tendency to fall asleep unintentionally during the day, and emotional lability, characterized by emotional outbursts and quick changes in mood, are prevalent amongst adolescents. They contribute to functional impairments and are inter-related, but are frequently investigated independently. In addition, sleep duration is related to both EDS and emotional/behavioral regulation, but previous studies did not take this into account. The aim of this study was to characterize the associations between emotional lability, impulsivity and EDS in adolescents while controlling for objectively measured sleep duration. It was hypothesized that higher levels of EDS in adolescents would be associated with higher levels of emotional lability and impulsivity in adolescents above and beyond the impact of sleep duration.

Methods: Participants included 52 typically developing adolescents (38 females) aged 11 to 16 years old (Mean age = 13.10 years, SD = 1.59). EDS was measured using the Sleep Disorders Inventory for Students. Emotional lability and impulsivity were measured using the Conners Global Index Scale. Sleep was measured using actigraphy and sleep logs.

Results: Parallel multiple regression analyses were conducted with EDS as the independent variable, and emotional lability or impulsivity as the dependent variables, while controlling for age, gender, bedtime, waketimes, and sleep duration. These analyses revealed significant positive association between EDS and emotional lability such that adolescents with high levels of EDS also presented with high levels of emotional lability ($F(6, 51) = 4.631$, $p = < .001$, $\beta = .62$, $p = <.001$). There were no significant associations found between EDS and impulsivity.

Conclusion: This study found that EDS was associated with emotional, but not behavioral, dysregulation in adolescents. Interventions aimed at reducing EDS and at improving adolescents' emotional regulation should be considered as a means to optimize adolescents' daytime functioning. Limitations of the current study include the use of a cross-sectional design that does not permit determination of causality. Future research should be conducted to better understand the mechanisms underlying the interplay between EDS and daytime functioning of adolescents.

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SLEEP OUTCOMES AND SLEEP-RELATED BEHAVIORS IN NICU GRADUATES

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Introduction: Previous studies of sleep patterns and problems in preterm infants and toddlers have yielded inconsistent results, with some studies noting differences on salient sleep parameters and others indicating similarities. Furthermore, little is known about any differences about sleep-related behaviors. Thus, the current aims of this study were to assess sleep patterns, problems, and sleep-related behaviors in young children born prematurely who were NICU graduates.
Methods: Caregivers of 262 children (53.4% boys; 35.9% Black, 40.5% White, 23.6% Other) being followed in a neonatal follow-up clinic at their corrected age one-year (10–16 months) or two-year (22–28 month) visit completed the Brief Infant Sleep Questionnaire-Revised SF (BISQ-R SF).
Results: At approximately one year of age, infants were going to bed at 8:36, taking 33 minutes to fall asleep, and waking .63 times per night for 19 minutes, for a total nighttime sleep duration of 8'01". Similarly, at approximately two years of age, infants were going to bed at 8:16, taking 26.7 minutes to fall asleep, and waking .94 times per night for 16.3 minutes, for a total nighttime sleep duration of 8'26". Sleep problems were reported by 18.1% and 19.6% of caregivers, respectively, with the majority indicating that their child slept well (78.5% and 76.5%) and minimal bedtime difficulties (13.6% and 14.6%). The majority of infants slept in their own crib (81%), with infants more likely to room share at 1-year compared to 2-year (49% vs 35%), and almost half falling asleep independently (43% and 46%).
Conclusion: Overall, sleep patterns and parent-perceived sleep problems (18–20%) in these NICU graduates were better than expected, and similar to normative data of similar age children (Sadeh et al., 2008). However, these infants/toddlers obtained less nighttime (8–8.5 hrs vs 10 hrs). Sleep education of parents of NICU graduates should not only focus on sleep behaviors, but also on ensuring sufficient sleep.
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SLEEP BRUXISM IN PRESCHOOL CHILDREN: ASSOCIATIONS WITH EMOTIONAL-BEHAVIORAL PROBLEMS

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Introduction: Several psychosocial factors contribute to the etiology of sleep bruxism in childhood, including emotional-behavioral problems, as well as environmental and familial factors. It is known that sleep bruxism is prevalent in preschoolers, but most etiology studies were conducted with school-aged children or adolescents. Studies focusing on younger, preschool-aged populations that consider family-related factors are lacking. This study aimed to assess the relationship between emotional-behavioral problems and the presence of sleep bruxism in preschoolers, while taking maternal depressive symptoms into consideration.
Methods: Three hundred eighty-three mother-child dyads from the Maternal Adversity, Vulnerability, and Neurodevelopment (MAVAN) cohort were included in the present study. Mothers completed the Child's Sleep Habits Questionnaires (CSHQ; includes the frequency of bruxism), a questionnaire about their child's emotional-behavioral problems (CBCL; anxiety and depressive problems), and reported their own depressive symptoms (CES-D). Measures were completed at two timepoints: when children were 4 and 5 years old. Generalized Estimating Equation (GEE) models were used to evaluate the relationship between sleep bruxism frequency and children's emotional-behavioral problems, while controlling for maternal depressive symptoms, child's biological sex, family socioeconomic status, and age.
Results: Maternal reports indicated that 12% of children experienced sleep bruxism at least sometimes at age four, and 20% did at age five. Children's anxiety and depressive symptoms were associated with increased sleep bruxism frequency ($p < 0.05$). Associations between children's emotional-behavioral problems and bruxism remained statistically significant when controlling for maternal depressive symptoms, child's biological sex, family socioeconomic status, and time ($p < 0.05$).
Conclusion: In this normative cohort of children, sleep bruxism was associated with anxiety and depressive symptoms in children as young as age four. Furthermore, this relationship can still be observed when the severity of maternal depressive symptoms is considered. Whether anxiety and depressive symptoms contribute to sleep bruxism, or vice versa, remain to be further investigated. Nevertheless, results suggest that screening of emotional-behavioral problems should be considered in children experiencing sleep bruxism.
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SLEEP VARIABILITY AND INFANT ANTHROPOMETRY DURING THE FIRST 6 MONTHS

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Introduction: Sleep plays a crucial role in children's health and development, and emerging evidence suggests that sleep disturbances during infancy negatively impact both the neurocognitive and socioemotional outcomes later in life. However, no study has taken the variability of sleep into account when examining physical growth in infancy, which is a critical period for both healthy sleep and weight development. The purpose of the study was to examine the association between sleep variability and physical growth in infants aged 6 months.
Methods: 316 healthy infants recruited during their 6-month well-child checkups had their weight and length measured, and wore an actigraph on the ankle for a week. Average weekday, weekend, and all week sleep duration were computed, with infants categorized into three groups: regular sleep, weekend catch-up sleep, and weekend sleep curtailment. General linear model analyses were performed with sleep variability as the primary predictor variable of interest and infant anthropometry as the dependent variable.
Results: Average weekday daily sleep duration was 10.76 (1.06) hours which was similar to the average weekend daily sleep duration of 10.68 (1.06) hours. In both unadjusted and adjusted models controlling for potential confounding variables, infants in the weekend catch-up sleep group (30.4%) and those in the weekend sleep curtailment group (34.5%) had significantly higher weight-to-length ratios, body mass index, and weight-for-age z scores when compared with infants in the regular sleep group (35.1%, all $p < 0.05$).
Conclusion: Weekday-weekend sleep pattern differences exist even as early as in the first 6 months of life, and either weekend catch-up

sleep or weekend sleep loss is associated with higher infant anthropometric markers. Our findings suggest that sleep assessments in infants in well-child checkups should include not only global assessments of average sleep duration but also address sleep pattern regularity.
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EXPLORING WAYS TO OPTIMIZE PARENTAL INVOLVEMENT IN ADOLESCENT SLEEP INTERVENTIONS

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Introduction: Sleep is critical to the health and functioning of adolescents, but most teens do not obtain the recommended amount of sleep each night. Some sleep interventions have been efficacious in promoting sleep among adolescents, though others have had a more limited impact. One potential strategy for improving the efficacy of adolescent sleep promotion programs is to optimize the role of parents in supporting their child's sleep. Recent findings on parental involvement in adolescent sleep suggest that monitoring can improve sleep duration but may be challenged by disagreements about sleep between parents and adolescents. Thus, it is crucial to understand how to involve parents in adolescent sleep promotion while supporting adolescent autonomy. Here, we report qualitative data on strategies for involving parents in adolescent sleep promotion in a way that is acceptable and effective. This data was collected specifically to inform the development of a sleep promotion program for adolescents.
Methods: We conducted 9 focus groups (3 each for youth, parents of adolescents, and healthcare providers treating adolescents). Transcripts of focus group proceedings were coded and thematically analyzed using inductive and deductive approaches, focusing on parents' current role in their child's sleep and the proposed role of parents in an adolescent sleep program.
Results: Some parents report being involved in their child's sleep habits by setting bedtimes and supervising a consistent sleep routine. Adolescents prefer parental support that encourages child autonomy for their own sleep routine. To maintain healthy sleep habits, parents report that physicians or other trusted adults may play a key role in facilitating the negotiation of sleep habits that addresses the priorities of both parents and adolescents.
Conclusion: Our findings support adolescent preference for autonomy in their health behaviors consistent with their developing independence during this development period. Future work should focus on improved understanding of how adolescents and parents can negotiate adolescent autonomy and should examine the efficacy of a sleep promotion program based on varying levels of parental involvement.
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DIFFERENTIAL IMPACT OF OVERNIGHT DELTA POWER DYNAMICS ON NEUROCOGNITION AMONG ADOLESCENTS WITH ADHD VERSUS HEALTHY CONTROLS

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Introduction: Attention-Deficit/Hyperactivity Disorder (ADHD) is associated with neurocognitive impairment; however, mechanisms contributing to neurocognitive deficits in ADHD are poorly understood. Sleep disturbance is common in ADHD, and our previous work has shown associations between overnight delta power dynamics (lower initial delta peak, slower delta decline) and poorer neurocognition among individuals with insomnia, suggesting these processes may underlie sleep restoration. This study investigates relationships between delta power dynamics and neurocognition among adolescents with ADHD versus healthy controls (HC).
Methods: In this ongoing study, 47 adolescents aged 13–17 (19 ADHD, 23 females, mean age=15.26) participated in a psychiatric evaluation and three nights of ambulatory polysomnography (PSG). Following the third night, participants completed the Cambridge Neuropsychological Test Automated Battery (CANTAB). Spectral analysis was conducted on a single O1-C3 channel and epochs were movement/artifact-free. Sleep variables were averaged over 3 nights. General linear models controlling for age, sex, total sleep time (TST), and wake after sleep onset (WASO) examined the effects of delta dynamics on neurocognition (summary score derived from principal components analysis of CANTAB subtests) and whether these associations differed across groups.
Results: PSG sleep variables did not differ by group (p's>.05). Significant effects of group ($F(7,36)=23.10$, $p<.0001$), delta decline ($F(7,36)=10.89$, $p=.002$), and the group by delta decline interaction ($F(7,36)=14.23$, $p=.0006$) were observed. Results regarding initial delta peak showed a similar pattern, with a trend toward a main effect of initial delta peak ($F(7,36)=3.53$, $p=.07$) and a significant group by initial delta peak interaction effect ($F(7,36)=9.91$, $p=.003$) on neurocognition. Lower initial delta peak and slower delta decline were associated with poorer cognition among ADHD, but not HC, youth after covarying for age, sex, TST, and WASO.
Conclusion: Overnight delta power dynamics may contribute to neurocognitive performance among adolescents with ADHD after accounting for sleep restriction and nighttime awakenings, highlighting the potential importance of sleep physiology in understanding neurocognitive deficits in this population. Future studies should identify whether there are phenotypic subgroups within ADHD characterized by disrupted overnight delta dynamics and examine whether insomnia treatments that impact delta decline (e.g., Cognitive-Behavioral Treatment—Insomnia) improve neurocognitive performance among adolescents with ADHD.
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COMPARISON OF SLEEP PARAMETERS IN CHILDREN WITH ACHONDROPLASIA AND TRISOMY 21

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Introduction: Children with achondroplasia and Trisomy 21 (T21) have increased incidence of sleep disturbances including sleep disordered breathing. Abnormal sleep architecture has been documented in children with T21. It is important to continue to analyze sleep parameters in both groups since poor sleep quality is associated with neurocognitive impairment.
Methods: Following IRB approval, we performed a retrospective chart review of patients at Nemours/A.I. duPont Hospital for Children in Wilmington, DE with achondroplasia and T21 who underwent an initial polysomnogram (PSG) between 2015 and 2020. We compared

sleep architecture parameters between the groups including sleep efficiency, total sleep time (TST), sleep latency, arousal index and concentration of N3 and REM sleep.
Results: In patients with achondroplasia (n=49, mean age 5.8 months and 63.3% male), 12% reported restless sleep. PSG data revealed TST of 392 minutes, mean sleep efficiency of 82%, mean sleep latency of 9.4 min, mean arousal index of 40, 22% REM sleep and 32% N3 sleep. In the patients with T21 (n=32, mean age 17.8 months and 50% male), 59% reported restless sleep. PSG data revealed TST of 393 minutes, mean sleep efficiency of 82%, mean sleep latency of 14 minutes, arousal index of 35, 15% REM sleep and 40% N3 sleep. The differences in REM and N3 sleep between the two groups were statistically significant (p-values of 0.001 and 0.04, respectively), but the differences in arousal index, TST and sleep efficiency were not.
Conclusion: Our study showed that children with T21 subjectively noted more restless sleep compared to patients with achondroplasia although TST and sleep efficiency were similar. Patients with achondroplasia had a higher arousal index that was not statistically significant. Children with achondroplasia had a shorter sleep latency and more robust REM concentration, likely due to their younger age. There was a higher concentration of N3 sleep in patients with T21. This is likely due to the decrease in REM concentration. In conclusion, it is important to establish expected sleep parameters in patients with achondroplasia and T21 to maximize sleep quality and mitigate negative neurocognitive effects of poor sleep.
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SLEEP MODERATES IMPROVEMENTS IN MENTAL HEALTH OUTCOMES IN YOUTH: BUILDING RESILIENCE FOR HEALTHY KIDS

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Introduction: To examine the role of sleep health in a school-based health coaching resiliency intervention for 6th grade students. We hypothesized that participants with insufficient sleep would have poorer mental health outcomes and that the intervention would be less successful for youth with poor sleep health.
Methods: A total of 285, 11-12-year-old students (72% white, 18% Hispanic, 55% female) participated in the six-week 1:1 Healthy Kids intervention. Youth completed electronic surveys at baseline and 6-week follow-up assessing mental health parameters and self-reported bed and wake time. Participants were categorized as having insufficient sleep opportunity if they reported time in bed of <9 hours per night. General linear models examined differences between groups for each mental health parameter, as well as change in mental health parameters from baseline to follow-up.
Results: A third of participants (31%) reported time in bed <9 hours per night. Youth with insufficient sleep were less often white (58% vs 73%; p<0.001) or Hispanic (26% vs 15%; p=0.04) and were more likely to be classified with mild to severe depression and anxiety (55% vs 35%; p=0.004). The health coaching intervention was found to have a significant improvement on overall resilience and self-efficacy only among students who reported sufficient sleep, while no significant intervention effect was found for those students who reported insufficient sleep.
Conclusion: Our findings suggest that youth with poor sleep health may not benefit from school-based resiliency and mental health interventions. Addressing sleep health may be an important consideration for future school-based mental health interventions.
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SOCIOECONOMIC STATUS AND CAREGIVER PERCEPTION OF YOUNG CHILDREN'S SLEEP

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Introduction: Socioeconomic status (SES) has been associated with variation in child sleep problems, but few studies have examined variation by SES in caregiver-reported early childhood sleep problems, patterns, and health behaviors. We hypothesized that, compared to higher-SES caregivers, lower-SES caregivers would report poorer sleep outcomes and sleep health behaviors, but lower rates of caregiver-perceived sleep problems.
Methods: A total of 309 caregivers (97% parents) of young children (M child age=3.59 years; 53.1% girls; 15% non-Hispanic/Latinx White, 57% non-Hispanic/Latinx Black, 20% Hispanic/Latinx White, 8% Hispanic/Latinx Black) completed the Brief Child Sleep Questionnaire. SES was measured via income level (lowest=$0-$20,000; middle= $20,001-$50,000; highest= $50,001 or greater).
Results: The prevalence of a caregiver-reported child sleep problem was similar across SES (17.6% of lowest SES group, 8.8% of middle, and 15.5% of highest, p>.05). However, ANCOVA models covarying for child race/ethnicity, age, caregiver age and education indicated sleep outcomes varied by SES. Caregivers in the lowest SES group reported significantly longer child sleep onset latency (SOL) than the middle or highest groups (p=.008), more frequent night wakings than those of middle SES (p=.009), and longer night waking duration than those of the highest SES, (p=.047). There were no significant differences by SES for child bedtime, total nighttime sleep, and total (24-hour) sleep duration. Logistic regression models with the same covariates showed no variation by SES for sleep behaviors, including caffeine consumption, presence of bedroom electronics, and bedtime resistance. Within each SES group, logistic regression models indicated that increased night wakings were uniquely associated with greater likelihood of endorsing a child sleep problem in the middle SES (p=.045) and highest SES groups (p=.040), but not in the lowest SES group.
Conclusion: Although caregiver-reported child sleep problems did not significantly differ across SES, lower-SES caregivers reported longer child sleep onset latency and increased number and duration of night wakings. Furthermore, night wakings were associated with perceived sleep problems, but only in middle and highest SES families. Clinicians should consider specific sleep parameters, such as SOL and night wakings, in addition to caregiver-reported child sleep problems when assessing and addressing child sleep problems, especially in lower-SES families.
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THE RELATIONSHIP BETWEEN BIRTH ORDER AND SLEEP PATTERNS IN 6-MONTH-OLDS

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Introduction: The influence of birth order has been investigated in many areas of child development, but few studies have examined its relationship with infant sleep; those that have yield contradictory findings. Moreover, nocturnal parental practices may differ depending on the number of children, but these characteristics are rarely studied. This study aimed to compare nocturnal parental practices and sleep patterns of first-born to non-first-born 6-month-olds.
Methods: The mothers of fifty-two 6-month-olds completed a 14-day sleep diary to record their infant's sleep. The following variables were averaged: total nocturnal sleep duration (in minutes), longest consecutive sleep duration (without interruption; in minutes) and number of nocturnal awakenings. Independent t-tests were used to compare each sleep variable between first-borns (n = 21) and non-first-borns (2nd, 3rd or 4th born, n = 31). Chi-square tests were used to compare parental sleep practices (breastfeeding frequency and infant sleep location) between first-borns and non-first-borns.
Results: First-borns had a longer consecutive nocturnal sleep duration (417.83 ± 142.42 vs. 310.08 ± 118.23; $p < .01$) and fewer nocturnal awakenings (1.69 ± 1.07 vs. 2.57 ± 1.09; $p < .01$) than non-first-borns. However, first-born and non-first-born infants did not differ in terms of total nocturnal sleep duration ($p > .05$). Breastfeeding frequency and sleep location differed as a function of birth order: 57.9% of first-born infants were exclusively breastfed, compared to 89.7% of non-firstborn infants ($\chi2$ (1, N = 52) = 6.56; $p < .05$). Furthermore, 20.0% of first-borns slept in the parents' room, compared to 56.7% of non-first-borns ($\chi2$ (1, N = 50) = 6.62; $p < .05$).
Conclusion: First-born infants had longer periods of consecutive sleep and fewer nocturnal awakenings than non-first-borns; however, birth order was not associated with maternal reports of total nocturnal sleep duration. These results suggest that non-first-borns have more fragmented sleep. Moreover, sleep-related practices also differed between mothers of first-born and non-first-born infants. A study conducted in a larger sample and using objective sleep measures could clarify whether these different sleep patterns reflect specific nocturnal parental sleep-related practices, or if the presence of other children in the home play a role in infant sleep consolidation.
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SLEEP PROBLEMS ARE ASSOCIATED WITH BEHAVIORAL PROBLEMS AND DECREASED QUALITY OF LIFE IN CHILDREN WITH FONTAN CIRCULATION

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Introduction: Children with congenital heart disease who undergo a Fontan procedure are at higher risk of behavior and attention problems as well as reduced quality of life compared to age-matched peers. While sleep problems are associated with behavior and attention problems in children without Fontan circulation, this relationship has never been examined in children with Fontan circulation. We hypothesized that sleep problems in this population may increase the risk of behavior problems and also reduce health related quality of life (HRQOL).
Methods: We analyzed data from the Pediatric Heart Network Fontan cross-sectional study to evaluate associations between a parent-reported diagnosis of a sleep problem with reported behavioral concerns and HRQOL as measured by the child health questionnaire (CHQ) in 558 children with Fontan circulation. Analysis was performed using logistic regression or Wilcoxon sum rank test, as appropriate, with Bonferroni correction for multiple comparisons.
Results: Parent-reported sleep problems were present in 10% of participants. Sleep problems were associated with a 4.6x higher risk of attention problems, 10.2x higher risk of anxiety problems, 3.9x higher risk of behavioral problems, 9.5x higher risk of depression, 5.0x higher risk of developmental delay, 6.9x higher risk of learning problems and 2.2x higher risk of speech problems ($p=0.04$ for speech problems, $p<0.001$ for all others). Parent report of a sleep problem was associated with decreased physical HRQOL (z-score -1.3 [interquartile range-2.2, -0.2] vs 0.0 [-0.8, 0.4], $p<0.001$) and psychosocial HRQOL (-0.9 [-1.9, 0.0] vs 0.0 [-0.8, 0.7], $p<0.001$) compared to children without a reported sleep problem. Report of a sleep problem was associated with significantly lower HRQOL across all subdomains of the CHQ ($p<0.05$ for all subdomains).
Conclusion: Children with Fontan circulation with sleep problems have an increased risk of behavioral and developmental problems as well as reduced HRQOL. Better understanding of sleep problems is needed in children with Fontan circulation, as sleep disorders may represent a reversible cause of behavioral problems and decreased HRQOL in this population.
Support (if any): Funding to DC from the American Heart Association, University of Arizona Health Sciences Center, and NIH-NHLBI. Fontan study data obtained from the Pediatric Heart Network.

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INCIDENCE & INFLUENCE OF DRUG SCREENING IN CHILDREN WITH HYPERSOMNOLENCE DURING MSLT: ANALYSIS OF THE CHILDREN'S WISCONSIN COHORT

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Introduction: The Multiple Sleep Latency Test (MSLT) is a validated test for evaluation of hypersomnolence in children and adults. AASM practice parameters recommend performing urine drug screens (UDS) in patients undergoing MSLT to identify substances that alter MSLT results. The study aims are to determine the incidence of positive UDS and their influence on MSLT variables in a cohort of children evaluated for hypersomnolence.
Methods: All children undergoing an MSLT in Children's Wisconsin sleep laboratory over an 8-year period (11/1/2012 to 9/30/2020) were included in this retrospective chart review study. Clinical and demographic data, including UDS results were manually abstracted. Record validation conducted by random allocation. Data were summarized as median and IQR or n (%). Chi-square test or Fisher's exact test were used to examine associations between categorical variables.
Results: 236 children completed an MSLT. The sample had a median age of 14.1 (IQR 10.5–16.2) years (50.9% female; 63.1% Caucasian). Narcolepsy I ("N1"; n=14; 5.9%), Narcolepsy II ("N2"; n=56; 23.7%), Idiopathic Hypersomnia ("IH"; n=39; 16.5%) were frequently diagnosed. Most children (97.9%) completed a UDS; 60.2% tested positive. Common substances found on UDS were caffeine (62.6%), OTC medications (40.3%), and prescription medications (33.8%), however nicotine (14.3%) and cannabis (5.8%) were also seen. Caffeine was commonly found in those diagnosed with N1 (70%), N2 (69.4%), and IH (54.2%). Fewer children diagnosed with narcolepsy were positive for prescription medications compared to those diagnosed with IH (21.7% versus 41.7%) although results did not reach significance ($p=0.08$). No child with N1 tested positive for prescription medications. ≥2 substances were found in 43.2% of positive drug screens. OTC medications and caffeine were most commonly co-occurring (23%); OTC analgesics being

the most common OTC medication. No association between positivity for >2 substances and sleep diagnosis was found (p=0.5).
Conclusion: More than half of children undergoing an MSLT had a positive UDS for >1 substance. The impact of these substances on PSG/MSLT parameters (total sleep time, mean sleep onset latency, sleep onset REM periods) is under investigation through additional analysis. Based on the above data our findings support the AASM guidelines of children obtaining a UDS on the day of MSLT.
Support (if any):

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LONGER SLOW WAVE SLEEP AND EXACERBATED CORE SYMPTOM SEVERITY IN AUTISM SPECTRUM DISORDER

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Introduction: Sleep disturbances in individuals with autism spectrum disorder (ASD) are common, yet previous studies have reported inconsistent findings on the associations between sleep architecture and core features of ASD. Our goal is to examine 1) the difference in sleep architecture, especially SWS, between children with ASD and typically developing controls (TD), 2) the association between SWS and core symptoms in ASD, and 3) the association of slow wave activity (SWA) spectral power and ASD symptoms.
Methods: We used ambulatory polysomnography (PSG) to record the sleep architecture in 61 children and adolescents (age 6 to 18) with ASD and 73 typically developing controls (TD) in their sleeping environment. We performed an analysis to examine 1) the difference in sleep architecture between ASD and TD, and 2) the association of SWS with core symptoms of ASD with the Autism Diagnostic Interview-Revised (ADI-R) and Repetitive Behavior Scale (RBS).
Results: Children and adolescents with ASD showed a higher SWS ratio and lower REM ratio than TD. Delta (1–4 Hz) relative power during total sleep was higher in ASD than TD. Further, a higher ratio of SWS predicted more severe behavioral symptoms as measured by the ADI-R and the Ritualized Behavior subscale of the RBS. Delta power did not show a significant association with core symptoms.
Conclusion: A higher ratio of SWS may reflect the neuronal immaturity specific to ASD in this age group. It may help us understand the underlying mechanism of the clinical symptoms in children with ASD.
Support (if any): Support for this work was provided to Dr. O'Hara by a grant from the Simons Foundation Autism Research Initiative (SFARI). Dr. Kawai is supported by the National Institute on Aging of the National Institutes of Health K23AG053465, and his contribution to this manuscript was made possible by an award from the American Sleep Medicine Foundation (#157-BS-16), a foundation of the American Academy of Sleep Medicine, 2018 NARSAD Young Investigator Grant from the Brain & Behavior Research Foundation, and Autism Working Group Award from Mosbacher Family Foundation. All authors gratefully acknowledge all participants and their families.

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EFFICACY OF A TREATMENT FOR SLEEP-RELATED PROBLEMS IN CHILDREN WITH ANXIETY: A MIXED METHODS STUDY

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Introduction: School-aged children with anxiety frequently experience sleep-related problems (SRPs) such as bedtime resistance. Results are mixed, but some children with anxiety also report longer sleep onset latency (SOL). Despite the link between SRPs and mental and physical health consequences, limited research has evaluated the efficacy of brief sleep treatments in this population.
Methods: A mixed methods approach employing a multiple-baseline single-case design and qualitative methods was used to evaluate the efficacy of a four-session parent training intervention in ten children with anxiety and chronic insomnia (M=9.6 years, range 8–12 years, 8 female). Questionnaires on SRPs and anxiety were completed by parents and children at baseline, one-week post-treatment, and one-month follow-up assessments. Subjective SOL (i.e., sleep diary) and objective SOL (i.e., actigraphy) were measured daily during assessment and treatment weeks. Parents and children completed qualitative interviews at the post-treatment assessment.
Results: The majority of participants no longer met criteria for chronic insomnia at post-treatment (n=9) or follow-up (n=6). SRPs (e.g., bedtime resistance) were significantly less frequent at post-treatment and follow-up than at baseline. The majority of participants demonstrated significant reductions in subjective (n=7) but not objective (n=3) SOL at post-treatment or follow-up compared to baseline. Qualitatively, parents and children described improvements in sleep during treatment. Some parents described discovering while completing sleep diaries that their child believed themselves to be taking longer to fall asleep at the beginning of treatment than they actually were (i.e., sleep misperception), and that this sleep misperception improved during treatment.
Conclusion: The findings of the current study support the preliminary efficacy of a brief parent training intervention to treat SRPs in school-aged children with anxiety. They also begin to help elucidate mixed findings in the literature on sleep of children with anxiety by providing a potential reason for discrepancies between subjective and objective SOL in this population. Specifically, qualitative findings suggest that this discrepancy may be related to sleep misperception, that children with anxiety may feel themselves to be taking a long time to fall asleep even when objective measures of SOL are within the normative range.
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COMPARING PARENTAL SLEEP GOALS FOR YOUNGER VERSUS OLDER TODDLERS

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Introduction: This study aimed to assess parental sleep goals, comparing younger (12-23.9-month-olds) and older toddlers (24-35.9-month-olds) in consideration of developmental differences.
Methods: Parents (98.0% mothers) of 401 toddlers (12–35 mos; M=22.49 mos; 49% male) in the US completed an online survey, including an abbreviated Brief Infant Sleep Questionnaire and a list of 58 desired areas of change (DACs). There were 230 one-year-olds (1yos; M=17.42mos) and 171 two-year-olds (2yos; M=29.30mos), with no difference in parent age between groups (M=34.41 years).
Results: 25.7% reported a perceived sleep-problem, whereas 94.8% indicated at least one sleep-related DAC. Parents of one- and two-year-olds reported similar rates of DAC for overnight sleep (58% vs. 49%), morning sleep (55% vs. 52%), and naps (70% vs. 64%), p>.05. Parents of 2yos, however, reported bedtime as a DAC at a higher rate (59% vs. 79%), p<.001. Twenty-five percent of specific bedtime DACs (n=8) were endorsed by ≥10% of parents. Parents endorsed falling asleep without an adult (17% of 1yos vs. 22% of 2yos) and falling asleep

without nursing (10% vs. 9%) at similar rates, p>.05. Parents of two-year-olds were more likely to endorse: getting through bedtime routine quickly/easily without stalling (10% vs. 30%,), earlier bedtime (10% vs. 24%), falling asleep faster at bedtime (24% vs. 10%), falling asleep without a pacifier (11% vs. 19%), falling asleep faster while alone (8% vs. 16%), and falling asleep without stalling/making requests (3% vs. 18%), p<.05.

Conclusion: The majority of parents of toddlers endorsed a sleep-related desired area of change, with two-thirds wanting to change something about bedtime and naps, and over half wanting to change something about overnight and morning sleep. Parents of older toddlers (2yos) were more likely to desire changes at bedtime than parents of younger toddlers (1yos), especially related to stalling and discontinuing pacifier use. As toddlers age, bedtime problems are more likely. Health care providers should be aware of developmental changes, such as increased language and assertions of independence, that seem to mostly affect bedtime when addressing sleep issues in toddlers.

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SELF-REPORTED SLEEP AND CIRCADIAN CHARACTERISTICS PREDICT FUTURE SUBSTANCE USE: A LONGITUDINAL ANALYSIS FROM THE NCANDA STUDY

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Introduction: Growing evidence indicates that sleep characteristics predict later substance use and related problems during adolescence and young adulthood. However, most prior studies have assessed a limited range of sleep characteristics, studied only a narrow age span, and included relatively few follow-up assessments. Here, we used multiple years of data from the National Consortium on Alcohol and Neurodevelopment in Adolescence (NCANDA) study, which spans the adolescent period with an accelerated longitudinal design, to examine whether multiple sleep characteristics in any year predict substance use the following year.

Methods: The sample included 831 participants (423 females; age 12–21 years at baseline) from NCANDA. Sleep variables included the previous year's circadian preference, sleep quality, daytime sleepiness, timing of midsleep (weekday and weekend), and sleep duration (weekday and weekend). Each sleep variable's association with the subsequent year's substance use (cannabis use or alcohol binge severity) across years 1–5 was tested separately using generalized linear mixed models (zero-inflated Negative Binomial for cannabis; ordinal for binge severity) with age, sex, race, visit, parental education, previous year's substance use (yes/no) as covariates and subject as a random effect.

Results: With regard to cannabis use, greater eveningness and shorter weekday sleep duration predicted an increased risk for additional days of cannabis use the following year, while greater eveningness and later weekend midsleep predicted a greater likelihood of any cannabis use the following year. With regard to alcohol binge severity, greater eveningness, greater daytime sleepiness, and shorter sleep duration (weekday and weekend) all predicted an increased risk for more severe alcohol bingeing the following year. Post-hoc stratified analyses indicated that some of these associations may differ between high school-age and college-age participants.

Conclusion: Our findings extend prior work, indicating that eveningness and later sleep timing, as well as shorter sleep duration, especially on weekdays, are risk factors for future cannabis use and alcohol misuse. These results underscore a need for greater attention to sleep characteristics as potential risk factors for substance use in adolescents and young adults and may inform future areas of intervention.

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SLEEP DISORDERS IN A LONGITUDINAL COMMUNITY COHORT OF CHILDREN WITH DOWN SYNDROME

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Introduction: Obstructive sleep apnea (OSA) affects 50–79% of children with Down Syndrome (CDS) prompting the development of guidelines to increase early detection of OSA. Cross-sectional survey based data shows that CDS have higher rates of bedtime resistance, sleep anxiety, night waking and parasomnias, which are also under-recognized. However, due to increased survival of CDS it may be that OSA treated in childhood returns or worsens, or that CDS may develop other sleep disorders as their life experience and exposure to comorbidities expands. Little is known about sleep disorders across the life span of CDS and screening guidelines leave a gap beyond early childhood. We determined to enhance understanding of respiratory and non-respiratory sleep disorders in a community population of CDS.

Methods: A retrospective population based observational study of CDS born between 1995–2011 was performed using the Rochester Epidemiology Project database. Medical records from all encounters through July 2020 were reviewed to identify sleep disorders. Sleep diagnoses, sleep test results, and treatments aimed at sleep disorders were recorded.

Results: 94 CDS were identified with 85 providing consent for research. 54 out of 85 individuals were diagnosed with OSA with 26 diagnosed prior to age 4 and 25 undergoing polysomnography prior to treatment. 26 individuals underwent polysomnography following surgery of which 16 continued to have clinically significant OSA requiring further treatment with secondary surgery, CPAP or anti-inflammatory therapy. Other sleep disorders observed included insomnia (n=16), restless leg syndrome (n=7), periodic limb movement disorder (n=10), idiopathic hypersomnia (n=1), nightmares (n=1), nocturnal enuresis (n=1), bruxism (n=1) and delayed sleep phase disorder (n=1). Most non-OSA sleep disorders were diagnosed during OSA evaluation by sleep medicine providers. However, many children were on melatonin without a formal sleep disorder diagnosis.

Conclusion: Both OSA and other sleep disorders remain underdiagnosed in CDS. This may be due to lack of validated screening tools that can be administered at the primary care level. Screening recommendations should consider the longitudinal nature of OSA in CDS and the presence of non-respiratory sleep disorders. Adenotonsillectomy is not as effective in CDS and postsurgical polysomnography is warranted along with long term follow-up to assess for further treatment needs.

Support (if any):

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EARLY PROTECTIVE FACTORS OF CHILD SLEEP QUALITY TRAJECTORY: RESULTS FROM THE HEALTHY BRAIN AND BEHAVIOR STUDY

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Introduction: Poor sleep quality is associated with many adverse health outcomes for children and adolescents. Recently, increasing knowledge has been gained for understanding risk factors for poor

sleep, but there is little knowledge about early protective factors for sleep quality in young people. The purpose of this study was to investigate whether prenatal obstetric and psychosocial factors, and happiness during childhood would predict child sleep quality across time.
Methods: A total of 290/454 children aged 11–12 years in the Healthy Brain and Behavior Study were included in analysis. Prenatal obstetric and psychosocial factors were recalled by mothers through structured interviews. Childhood happiness and child sleep quality across 1, 3, 5, 11, and 12 years of age were reported by mothers through questionnaires. Two-level linear mixed-effects modeling was conducted.
Results: Overall, children's average sleep quality increased from 1 to 5 years, followed by a decrease during 5 to 12 years. Prenatal care ($\beta = 0.376$, SE = 0.169, $p = 0.027$), better maternal psychosocial support during pregnancy ($\beta = 0.045$, SE = 0.016, $p = 0.007$), and higher childhood happiness ($\beta = 1.333$, SE = 0.274, $p < 0.001$) were associated with better sleep quality across childhood. Childhood happiness during previous developmental age predicts better sleep quality at later age ($\beta = 1.526$, SE = 0.350, $p < 0.001$). Other prenatal factors including prenatal gestation and parturition history, substance use during pregnancy, maternal labor and delivery complications, and neonatal conditions were not associated with child sleep quality trajectory.
Conclusion: Prenatal care, prenatal psychosocial support, and childhood happiness are protective factors of child sleep quality across 1–12 years of age. Future prospective longitudinal studies are needed to understand the causal relationship between early protective factors and sleep quality in childhood and adolescence.
Support (if any): This study is supported by the Pennsylvania Department of Health (SAP# 4100043366), the Clinical & Translational Research Center, Perelman School of Medicine, University of Pennsylvania (grant number UL1-RR-024134).

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VARIATION IN SLEEP BELIEFS AND BEHAVIORS AMONG CAREGIVER-CHILD DYADS PARTICIPATING IN A SLEEP EXTENSION INTERVENTION

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Introduction: Given the high prevalence and poor outcomes of insufficient child sleep, effective interventions for the pediatric primary care setting are needed. Collecting family perspectives on intervention strategies is critical to understand and enhance outcomes, particularly among children who do not experience improvements. This study examined variation in qualitative family sleep beliefs and behaviors by quantitative child sleep outcomes of a sleep extension intervention.
Methods: A total of 24 caregiver-child dyads (child age 9–12 years, M age 11.3 (SD:1.0) years; 46% male; 50% non-Latinx White; 29% Black) participated in a mobile health sleep extension intervention, between March-December 2019, and completed post-intervention semi-structured telephone interviews to solicit intervention perceptions. The intervention used a 25 factorial design consisting of sleep duration goals and weekly performance feedback, with random assignment to sleep health promotion messaging and financial incentive conditions. Sleep duration was assessed via Fitbit Flex 2 devices during 2-week baseline and 7-week intervention periods. We developed a codebook using a grounded theory approach and conducted coding in NVivo. We compared preliminary qualitative themes among children who showed a >=30-minute improvement in sleep duration ('responders') versus those who did not ('non-responders').
Results: Of the 24 dyads, 38% (N=9 dyads) were classified as non-responders. Preliminary qualitative themes included: family beliefs about sleep and electronics usage; the study impact on sleep behaviors; and an enhanced awareness of child sleep. Intervention responder and non-responder dyads similarly described family restrictions on evening electronics usage (e.g., electronic parental controls; physical removal of devices) to benefit child sleep. However, more children classified as intervention responders described the benefits of these restrictions and expressed beliefs about the negative impacts of electronics on sleep. Whereas caregivers of both responders and non-responders described efforts to remind their child to go to bed earlier during the intervention, caregivers in the responder group described being more focused on and active in child sleep extension strategies. These included setting bedtime reminders and adjusting family activities to ensure an extended sleep schedule.
Conclusion: Addressing caregiver-child beliefs about sleep behaviors and engagement in sleep extension strategies could augment sleep extension intervention outcomes in future research.
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THE DEVELOPMENT AND PSYCHOMETRICS OF AN ASSESSMENT OF CHILDREN'S SLEEP ENVIRONMENTS

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Introduction: Approximately half of school-aged children (ages 5–18) get either insufficient sleep during school nights or barely meet the required amount of sleep expected for healthy functioning (National Sleep Foundation, 2014).This percentage increases as children develop into adolescents (National Sleep Foundation, 2006). Accordingly, sleep problems and insufficient sleep are so pervasive that they could be considered an epidemic due to their adverse impact on children's mental and physical health (Owens, 2015; Shochat et al., 2014). Fundamental to children's sleep health is their sleep environment (Billings et al., 2019; Spilsbury et al., 2005). Despite its importance, however, there remains a noticeable absence of valid and reliable assessments of this construct. The current study sought to develop a measure of children's sleep environments to support research and clinical work on youth's sleep health.
Methods: A total of 813 parents (Mage = 40.6, SD = 8.6; 72% female) completed an online survey regarding their child's (Mage = 10.5, SD = 3.8; 45% female) sleep environment and sleep-related behavior. The majority of families identified as Caucasian (approximately 80%). Parents reported fairly high annual incomes (Median = $75,000), but 28.2% of families reported incomes less than $50,000. A total of 18 items (total scale score; alpha = .74) were selected from a pool of 38 items developed from previous research that examined aspects of the sleep environment and were entered into an exploratory factor analysis from which 4 factors emerged: general sleep environment (10 items, alpha = .91), sleeping alone vs. with siblings (2 items, alpha = .78), presence of electronic screens (4 items, alpha = .75), and emotional environment (2 items, alpha = .80).
Results: The subscales demonstrated distinct patterns of correlations with related constructs, and unique predictive variance in explaining children's daytime sleepiness even after controlling for children's sleep hygiene, behavior problems, and sleep problems.

Conclusion: The current study is one of the first to demonstrate a valid/reliable assessment of children's sleep environments. Not only will this measure provide researchers with an assessment of a fundamental influence on children's sleep, but it will also enable clinicians to better measure this construct and support effective sleep health recommendations.
Support (if any):

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SLEEP RESTRICTION LEADS TO FEWER PROSOCIAL RESPONSES TO AMBIGUOUS SOCIAL VIGNETTES AMONG SCHOOL-AGED CHILDREN

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Introduction: Introduction. After sleep deprivation, adults demonstrate reduced ability to accurately discriminate socio-emotional cues, including increased perceptions of threat and decreased recognition of subtle emotional facial expressions. Experimental studies in youth are far more limited, but sleep loss may have more profound effects on detection of socio-emotional cues during development when these abilities are still developing. The current study therefore compared children's responses to ambiguous social vignettes after a night of adequate sleep and two nights of sleep restriction (SR). We hypothesized that SR would result in fewer pro-social responses compared to when children were rested.
Methods: Methods. A total of 53 healthy children aged 7–11 years old (M = 9.08, SD = 1.34; 56.6% female) completed two counterbalanced emotional assessments; one after a night of 10 hours in bed (assessed via at-home polysomnography) and one a week later after two consecutive nights of SR (7 hours and 6 hours in bed, respectively). At each assessment, children listened to three brief stories depicting ambiguous social vignettes with peers or adults. After each story, children were asked what they would do next in the situation. Responses were recorded verbatim and later coded by blind raters as prosocial, avoidant, aggressive, or ambivalent.
Results: Results. A difference in response type was detected for one of the three types of vignettes after SR compared to when rested ($\chi 2$ (1) = 4.51, p = .02). Specifically, stories including ambiguous actions of another child at school resulted in 1.47 lower odds of a prosocial response compared to all other types when children were sleep restricted.
Conclusion: Conclusion. Our preliminary findings suggest that inadequate sleep may undermine children's behavioral responses in ambiguous social situations with peers. These preliminary results require replication, but such investigations may provide greater insight into mechanism that explain documented relationships between sleep and social problems in childhood.
Support (if any):

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RESTLESS SLEEP AND OTHER COMORBIDITIES IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

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Introduction: The etiology of restless sleep has recently been identified as secondary to various medical and sleep conditions. Parents of children with ADHD complain of restless sleep and sleep disturbances in their children. We aimed to assess restless sleep causes in our patient population with ADHD and establish the prevalence of restless sleep disorder (RSD), as recently defined.
Methods: A retrospective study of children with ADHD who underwent polysomnography was carried out. Diagnostic and descriptive information collected for each patient included age, sex, polysomnographic parameters, sleep disorders, psychiatric comorbidities, and medications.
Results: Sixty-six PSGs were reviewed. The mean age of children was 11.6 (±3.6 SD) years; 17 were female and 49 were male. Parents of 54 (81.1%) children had concerns of restlessness during sleep; 47 (71.2%) children had obstructive sleep apnea, 17 (25.8%) had PLMS ≥5/hour, 13 (19.7%) had RLS, 6 (9.1%) had RSD, 27 (41%) had depression or anxiety, 5 (7.6%) had insomnia.
Conclusion: In a pediatric sleep medicine referred group of patients with ADHD, who are known to have significant sleep and psychiatric comorbidities, obstructive sleep apnea, RLS, and RSD were found to be the most prevalent sleep disorders, whereas depression and anxiety were the most common psychiatric disorders. Complaint of secondary restless sleep seems to be common, while primary restless sleep disorder was seen in approximately 9% of children. The results of this study aid pediatricians and child psychiatrists in screening children with ADHD for associated sleep disorders.
Support (if any):

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ELECTROCARDIOGRAM ABNORMALITIES IN CHILDREN UNDERGOING POLYSOMNOGRAPHY

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Introduction: Monitoring electrocardiogram (EKG) is an integral component of pediatric polysomnography (PSG). There is limited data regarding arrhythmia and conduction disturbances in the pediatric population undergoing a PSG. In this work we will present abnormal EKG findings during PSG in our sleep center.
Methods: A retrospective chart review from children at Seattle Children's Hospital who underwent PSG read by a single Sleep Medicine physician (LD) in the last year was carried out. Data included age, sex, type of EKG abnormality, sleep diagnosis from PSG. Data from children with 1st or 2nd degree atrioventricular block (AVB) were compared to those from children with premature ventricular contractions (PVC).
Results: A total of 1,235 PSG were included. Twenty-four children (9 girls and 15 boys) aged 2–17 years (median 9 years) were identified with arrhythmias or conduction disturbances (1.9%). Nineteen out of 24 of these children (79.2%) had oAHI >1/hour; this frequency was not significantly different from that found in the whole group of 1,235 children (Chi-square test p=0.16). When comparing PSG parameters from children with AVB with those with PVC, we found no statistically significant difference. Seven out of nine children with AVB and seven out of ten with PVC had oAHI >1/hour (Fisher exact test p=0.56) while eight children with AVB out of nine and four out of ten with PVC were males, and this difference was the only statistically significant difference found (Fisher exact test p=0.04). None of the children were found to have a structural or conduction abnormality when referred to cardiology.
Conclusion: Our study found ECG abnormalities in 1.9 % of children undergoing PSG. None of the children were found to have abnormal

findings after cardiology referral. Our study supports that EKG abnormalities are rare in PSGs of children and not associated with cardiac disease or sleep disorders, but appear more commonly in males.
Support (if any):

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QUALITATIVE ANALYSIS OF BEDTIME CHALLENGES AND PARENTAL INTERVENTIONS IN FOSTER CARE CHILDREN

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Introduction: Sleep during childhood has a major impact on physiological, psychological, and cognitive development. Limited research has focused on vulnerable populations such as children in foster care. Foster care children endure placement instability, which may contribute to disrupted sleep patterns and unpredictability around bedtime (Leathers, et al., 2019). The Fostering Sleep study examined foster caregivers' perceptions of children's sleep challenges and strategies for improving sleep difficulties.
Methods: Foster caregivers of children ages 4–11 throughout the US were invited to complete the Qualtrics Sleep Health among Children in Foster Care Survey via foster care Facebook groups. The survey included quantitative and qualitative questions focused on sleep patterns and behaviors. Qualitative questions on barriers and opportunities to improve sleep were examined: what helps foster care children sleep well; what kinds of difficulties do foster care children experience at bedtime?
Results: 483 foster care parents responded. Responses to bedtime difficulties were coded using 27 categories (e.g., parasomnias, bedtime resistance, trouble self-soothing); responses to what helps your child sleep well were coded based on 22 categories (e.g., comfort items, melatonin, TV as in intervention, communication to reassure safety). The most prevalent sleep/bedtime difficulties were fear/anxiety (23.2%), nightmares (19.6%), environment (18.4%). For example, one parent responded: "He fears never waking up. He fears that the sun is not going to come back up. He fears that the bad guys will come get him." Difficulties varied by age-- 4–5: fear/anxiety, destabilization from call/visit biological parent, nightmares; 6–9: nightmares, fear/anxiety, environment; 10–11: fear/anxiety, nightmares, emotional/behavioral difficulties. Most frequent parenting approaches were bedtime routine (63.0%), reading before bedtime (36.5%), physical reassurance (26.6%). Interventions also varied according to age-- 4–5: routine, reading, physical reassurance; 6–9: routine, reading, noise control; 10–11: routine, technology regulation, reading.
Conclusion: Foster caregivers reported fear/anxiety as most common bedtime difficulty and physical reassurance as most frequent parenting strategy for healthy sleep. Findings suggest that anxiety and fear often interfere with sleep and, in turn, physical reassurance as a helpful bedtime strategy. Undoubtedly, there is a need for sleep research and preventive interventions for children in foster care.
Support (if any): Summer Student Research Support, Loyola University Maryland, College of Arts and Sciences

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ELECTRONIC MEDIA USE AND SLEEP AMONG CHILDREN IN FOSTER CARE WITH ANXIETY

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Introduction: Electronic media (EM) use has long been associated with poor sleep in children. Children's use of EM may also be related to emotional distress – anxiety being one of the more prevalent issues, which has been tied to sleep-related problems as well (e.g., Fors & Barch, 2019; Alfano et al., 2007). Children in foster care have often been victims of trauma, which can lead to significant emotional and sleep difficulties (e.g., Kovachy et al., 2013). The Fostering Sleep study examined the association between EM use and sleep among children in foster care; and the additional influence of anxiety.
Methods: Participants were caregivers of foster care children recruited from private Facebook foster care support groups across the United States. The study used a cross-sectional design examining sleep patterns and behaviors, EM use and mental health among children in foster care. An online survey, hosted by Qualtrics, was distributed to caregivers via Facebook. The data of 443 foster care children between the ages of four and 11 (M=6.37, SD=2.21) were included in the analyses.
Results: Children in foster care using EM at bedtime go to bed later than those who are not ($p<.001$), and their sleep quality was better than those who did not use EM around bedtime ($p<0.01$). Additionally, 33.3% reported anxiety as a primary diagnosis by a mental health professional. Children without anxiety as their primary diagnosis were found to be more likely to use EM around bedtime ($p=.038$).
Conclusion: This preliminary analysis indicates the prevalence of EM use close to bedtime may not necessarily be detrimental to sleep for this population; perhaps activities such as watching one's favorite programming or talking to a loved one online can be comforting and therefore helpful to sleep onset (Eggermont & Van den Bulck, 2006). However, examination of other factors such as type of technology, content of media, and duration of use is warranted. Moreover, children with anxiety as a primary diagnosis may be using less EM at bedtime because EM use may trigger symptoms of anxiety (i.e., Fors & Barch, 2019).
Support (if any):

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DESCRIPTION OF 14&6 VARIANT ON POLYSOMNOGRAPHY

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Introduction: Benign variants or incidental findings are often identified on routine polysomnography. One such variant is 14-and-6 hertz positive spikes, first described on EEG in 1951; however, the significance of 14-and-6 positive spikes found on polysomnography has not been previously described.
Methods: We conducted a retrospective review of patients with 14-and-6 Hz spikes on polysomnography and compared clinical findings on polysomnography with age and sex-matched controls.
Results: Mean age was 8.6 years (range 2–16). Sleep indices did not differ between cases and controls. Patients with 14-and-6 Hz spikes had lower obstructive apnea-hypopnea index and were less likely to be diagnosed with obstructive sleep apnea. Patients with 14-and-6 Hz spikes did not differ from controls in frequency of formal neurology evaluation, whether a full EEG was obtained, or neurologic diagnoses. Patients with 14-and-6 Hz spikes were less likely to be diagnosed with behavioral or developmental disorders.

Conclusion: 14-and-6 Hz spikes can be seen in children of all ages and does not seem to be associated with any sleep, neurologic, or developmental disorders.
Support (if any):

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ASSOCIATION OF E-CIGARETTE AND TOBACCO USE WITH ADOLESCENT SLEEP QUALITY

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Introduction: Recently, targeted marketing has encouraged teen e-cigarette vaping. Although e-cigarettes are often presented as a safe alternative to conventional tobacco, their toxicity is unclear. In adults, we have previously observed a link between dual usage of e-cigarettes and tobacco with increased sleep latency. We hypothesized an association between dual usage and increased sleep latency.
Methods: Participants were recruited to complete social media surveys. We performed three surveys: Survey 1 (n=47) in 2018, Survey 2 (n=1198) in 2019, and Survey 3 (n=564) in 2020. Surveys 1 and 2 had three sections: past and current inhalant use, the Pittsburgh Sleep Quality Index (PSQI), and the Leicester Cough Questionnaire (LCQ). Survey 3 did not include the LCQ, instead including the Hospital Anxiety and Depression Scale (HADS) and Patient Health Questionnaire (PHQ9). The adolescent data (aged 13–20 years; n=609) were isolated.
Results: Adolescents reported an increase in sleep duration with increasing age by one-way ANOVA. Males reported no change with increasing age, while, by Tukey's multiple comparisons test, females got significantly more sleep at ages 19 and 20 than at age 14($p<0.01$). There was no significant correlation between inhalant use and sleep duration. When broken down by gender, female dual users slept more than female nonsmokers,($p=0.01$; mean difference=43.8 minutes; CI=0.11 to 1.36), while there was no difference in males. We observed a significant association between inhalant use and sleep($p=0.0008$), with dual use correlated with a longer sleep latency than nonsmokers (mean difference=6.27 minutes; CI=1.40 to 11.13. We saw no correlation between inhalant use and anxiety or depression, nor between inhalant use and cough severity and prevalence.
Conclusion: In female adolescents, we observed a peak in sleep hours at age 19 but significantly less sleep in fourteen-year olds. College-aged females may have a later wake time relative to middle-school and high-school aged females. Dual inhalant use in females was associated with a long sleep duration, raising concern for sleep disruption caused by dual use. Dual use's association with increased sleep latency raises concern for nicotine-induced wakefulness. Further data are required in order to define public health strategies.
Support (if any): LCA is supported by NIH.

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BEDTIME, SLEEP DURATION, AND SLEEP QUALITY AS PREDICTORS OF EXTERNALIZING SYMPTOMS IN CHILDREN IN FOSTER CARE

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Introduction: A strong association between sleep disturbances and externalizing symptoms has been found among school-aged children. In particular, there is a known association between sleep disturbances, irritability, emotional dysregulation, and hyperactivity (e.g., Coto et al., 2018). Limited research, however, has examined this association in a high-risk population of children, such as those in foster care who are at increased risk for sleep disturbances due to heightened exposure to trauma. Thus, the following study sought to assess the association between sleep quality and externalizing symptoms in a population of children in foster care.
Methods: Caregivers with children ages 4–11 were sampled from private Facebook community foster care groups across the United States (n = 410). Caregivers were provided a link to a survey powered by Qualtrics where they were asked to report on the children under their care's weekday bedtime, overall sleep quality (e.g., "Please rate your child's overall sleep quality over the last two weeks"), and sleep onset (e.g. "On weekdays, how long does it usually take for your child to fall asleep?"). Child behavioral issues were assessed via the Eyberg Child Behavior Inventory (ECBI) Parent Rating Form.
Results: A linear regression model was utilized to assess if child weekday bedtime, weekday total sleep duration, and overall sleep quality were unique predictors of externalizing symptoms when controlling for age. Results suggest that weekday sleep duration and bedtime were not significant unique predictors of child behavioral issues, though were significantly and positively correlated at the bivariate level ($p=.02$, $p=.04$). Sleep onset and overall sleep quality, irrespective of child age, were found to be significant unique predictors of child behavioral issues and accounted for 1% and 11% of the total variance, respectively.
Conclusion: Results suggest that delayed sleep onset and poorer sleep quality were predictive of increased behavioral issues for children in foster care. Findings persisted when controlling for age, which suggests that children in foster care experiencing sleep disturbances may benefit from more behaviorally focused sleep interventions to improve externalizing behaviors and increase sleep health.
Support (if any):

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MELATONIN USE IN THE PEDIATRIC INTENSIVE CARE UNIT: 5 YEAR SINGLE CENTER EXPERIENCE

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Introduction: Pediatric patients requiring intensive care are at risk for unavoidable sleep and circadian disturbances because of the frequency and nature of delivering care for severe illness in this setting. There is growing appreciation for sleep as an essential component for neuropsychological and physical health. While exogenous influences (light and noise) and endogenous evaluation (melatonin levels) have been evaluated in this setting, there has not yet been investigation of current practice for exogenously administered melatonin in the pediatric intensive care unit (PICU). We aimed to evaluate baseline practice and changes in melatonin administration after implementation of delirium education.
Methods: In 2018, pediatric delirium education was implemented and included identification of sleep disturbance. A 5-year retrospective chart review (3-years baseline and 2-years after delirium education) was completed based on a pharmacy database that identified all patients who had melatonin administration while in PICU. Each admission was counted as an unique encounter. Data collection included patient age, date of admission, and length of stay (LOS). Data for melatonin included dose, starting date, duration of treatment (number of days), and indication. Indications for melatonin were (1) delirium, (2) insomnia,

(3) circadian sleep wake disorder, (4) previous home medication, and (5) unable to determine from chart review.
Results: Over 5 years (2015 – 2020), 182 (6.0%) patients admitted to PICU (average age 9.3 +/- 5.8 years, average LOS 24.9 +/- 56.3 days) were given melatonin (average dose 4.0 +/- 2.3 mg). The most frequent indication for melatonin administration was continuation as a home medication (45.9%) and least frequent was sleep-wake disturbance (3.9%). The percentage of patients given melatonin as compared to total PICU admissions, nearly doubled from 4.4% in baseline group to 8.2% in post-delirium-education group. Further, "delirium" as indication for melatonin increased from 5.2% (baseline) to 15.4% (post-education). There were no notable changes for administration indication "insomnia" (18.2% vs 19.2%) or "unknown" (22.1% vs 19.2%).
Conclusion: This is the first exploratory study to evaluate frequency and indication of melatonin use in the PICU and changes in practice after implementing delirium education. Delirium education that includes sleep disturbance has had significant impact on frequency of melatonin administration.
Support (if any):

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THE ASSOCIATION OF CIRCADIAN RHYTHMS WITH COGNITIVE FUNCTIONING IN CHILDREN WITH ATTENTION-DEFICIT HYPERACTIVITY DISORDER

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Introduction: Disrupted circadian rhythms is associated with impaired cognitive function. Although circadian rhythm disturbances are commonly seen in individuals with attention-deficit hyperactivity disorder (ADHD), whether their cognitive functioning is thus affected remains unclear. This study aimed to examine the associations of circadian-related parameters with different cognitive abilities in children with ADHD.
Methods: Fifty-seven children with ADHD were recruited into this study (age range: 6–12 years, 66.7% male). They were assessed by parent-report questionnaires on sleep problems (Children's Sleep Habits Questionnaire, CSHQ), and ADHD symptoms (Strengths and Weaknesses of ADHD Symptoms and Normal Behaviour Scale). Actigraphic data collected for seven consecutive days were analyzed using parametric and nonparametric methods. Cognitive functioning was assessed with Continuous Performance Test (CPT) for sustained attention, Letter-digit test for processing speed, Digit Span test and N-back task for working memory, Tower of London test for planning skills and Bergs Card Sorting Test for set-shifting ability. The relationship between circadian parameters and cognitive performance was analyzed using multiple regression while controlling for age, sex, ADHD medication, the day of cognitive assessment (school days vs non-school days), total sleep time, and CSHQ total score.
Results: Increased activity during the most active 10-h period of the day (St. $\beta = 0.39$, $p = 0.012$) was related to more omission errors on CPT, and later onset of the least active 5-h period of the day (St. $\beta = 0.44$, $p = 0.004$) was associated with longer correct reaction time on CPT. Lower relative amplitude was associated with poorer performance on Digit Span (St. $\beta = 0.33$, $p = 0.042$). No significant associations were found between the circadian-related parameters and the performance on other tasks measuring processing speed and executive functions.
Conclusion: Circadian rest-activity rhythms (blunted rest-activity rhythms, higher daytime activity, and later onset of nocturnal rest) were associated with cognitive functioning in ADHD children. Future longitudinal studies are needed to explore the long-term impact of circadian rhythm disturbances and the effects of circadian-focused intervention on cognitive functioning in ADHD children.
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THE ASSOCIATION BETWEEN CIRCADIAN RHYTHMS AND PSYCHOSOCIAL FUNCTIONING IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

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Introduction: Circadian rhythm disturbances, including delayed circadian rhythm and increased motor activity, are commonly seen in attention-deficit hyperactivity disorder (ADHD). Previous research suggested a link between circadian rhythm disturbances and poor psychosocial functioning in children, but such a relationship has not been examined in children with ADHD. This study aimed at examining the association between circadian-related parameters and psychosocial functioning in children with ADHD.
Methods: Seventy-nine children with ADHD were recruited into this study (age range: 6–12 years, 75.9% male). They were assessed by parent-report questionnaires on sleep problems (Children's Sleep Habits Questionnaire, CSHQ), ADHD symptoms (Strengths and Weaknesses of ADHD Symptoms and Normal Behaviour Scale, SWAN), and psychosocial functioning (Strengths and Difficulties Questionnaire, SDQ). Actigraphic data collected for seven consecutive days were analyzed using parametric and nonparametric methods. The relationship between circadian parameters and psychosocial functioning was analyzed using multiple regression while controlling for age, sex, ADHD medication, total sleep time, and CSHQ total score.
Results: Later acrophase was significantly associated with higher scores on SDQ emotional problems (St. $\beta = 0.30$, $p = 0.03$) and SWAN inattention subscale (St. $\beta = 0.27$, $p = 0.043$). Lower relative amplitude was associated with higher scores on SDQ hyperactivity symptoms (St. $\beta = -0.29$, $p = 0.045$) and SDQ total difficulties (St. $\beta = -0.31$, $p = 0.036$). Higher levels of mean activity level during the least active 5-h period (L5) were related to higher scores on SDQ peer problems (St. $\beta = 0.38$, $p = 0.021$), SDQ internalizing problems (St. $\beta = 0.38$, $p = 0.020$) and SDQ total difficulties (St. $\beta = 0.33$, $p = 0.036$). Later onset of L5 was associated with increased SDQ emotional problems (St. $\beta = 0.26$, $p = 0.046$).
Conclusion: Circadian rest-activity rhythm disturbances (delayed phase, blunted rest-activity rhythms, higher level of nocturnal activity, and later onset of nocturnal rest) were associated with poor psychosocial functioning in children with ADHD. Further longitudinal studies are needed to examine the effects of circadian disruption on psychosocial functioning in children with ADHD.
Support (if any): This work was supported by the Health and Medical Research Fund (Project No.: 30160604).

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ASSOCIATION BETWEEN CO-SLEEP AND BEHAVIORAL PROBLEMS AMONG PRESCHOOLERS IN TAIWAN

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Introduction: 'Co-sleep' is defined as the sleep arrangements in which parents and their child sharing a sleeping surface (bed-sharing or room-sharing). Similar to the other Asian countries, Taiwan has a high reported rates of bed-sharing. Previous researches had shown shorter sleep duration and poorer sleep quality in children with co-sleep. However, the association between co-sleep and the children's emotional and behavioral problems has not been well studied. This study aims to explore the association between sleeping arrangements and children's sleep, as well as their daytime emotional and behavioral problems.
Methods: 9,582 caregivers of preschoolers (age= 4.70±0.806; Male: Female=52%:48%) completed a questionnaire regarding their children's sleep schedule, the Children's Sleep Habits Questionnaire (CSHQ) and Strength and Difficulties Questions (SDQ). The reported frequency on the items of the CHSQ question regarding co-sleep, asking whether the child falls asleep in parent's or sibling' s bed or sleep alone, were used to divide the children into three groups: usually co-sleep group, sometimes co-sleep group and sleep-alone group.
Results: Among 2,967 preschoolers, 6,272 children (65.5%) reported usually co-sleep, 816 children (8.5%) reported sometimes co-sleep, and 2,494 children (26%) reported sleeping alone. One-way ANOVAs showed significant differences among three groups in: 1) sleep patterns, including weekday nighttime sleep duration ($F=24.43$, $p<.01$), weekend nighttime sleep duration ($F=3.13$, $p<.05$), weekday nap duration ($F=4.24$, $p<.05$), and weekend nap time ($F=4.39$, $p<.05$); 2) sleep problems on the CHSQ, including bed time resistance ($F=7027.25$, $p<.01$), sleep onset delay ($F=33.06$, $p<.01$), sleep duration ($F=65.51$, $p<.01$), sleep anxiety ($F=788.48$, $p<.01$), night waking ($F=37.90$, $p<.01$), parasomnias ($F=47.43$, $p<.01$), sleep disorder breathing ($F=7.58$, $p<.01$), and sleepiness ($F=13.44$, $p<.01$); 3) behavioral problems and development on the SDQ, including hyperactivity ($F=21.16$, $p<.01$), emotional symptom ($F=23.08$, $p<.01$), conduct problem ($F=8.65$, $p<.01$), peer problems ($F=20.59$, $p<.01$), and prosocial ($F=17.67$, $p<.01$).
Conclusion: Our results indicate that children with more frequent co-sleep may have shorter sleep duration, more sleep problems as well as more external and internal behavioral problems, while sleep-alone children showed more prosocial behaviors, longer sleep duration, and less sleep problems. The potential developmental problems related to co-sleep may be underestimated in Asian culture and need more attentions.
Support (if any):

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ADOLESCENT DELAYED SLEEP PHASE AND CIRCADIAN IRREGULARITY ASSOCIATED WITH SUBSTANCE (MIS) USE IN YOUNG ADULTHOOD

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Introduction: Substance use disorders are reaching epidemic proportions among adolescents and young adults. While disturbed, insufficient sleep is known to be associated with substance use, little is known about the role of circadian misalignment in precipitating or perpetuating substance misuse.
Methods: The Penn State Child Cohort is a population-based sample of 700 children (Mdn=9y), who were followed-up 8 years later as adolescents (N=421, Mdn=16y) and 15 years later as young adults (N=492, Mdn=24y). In adolescence, a delayed sleep phase was defined as a 7-night actigraphy-measured mean sleep midpoint later than 4:00 AM, while an irregular circadian phase as a within-subjects standard deviation in sleep midpoint greater than 1 hour. Alcohol, tobacco, and drug use was ascertained by parent- and/or self-reports in adolescence, while alcohol, tobacco and marijuana use was ascertained by self-reports in young adulthood. Logistic regression models tested the association between delayed and irregular circadian phase with substance use adjusted for age, sex, race/ethnicity, BMI, SES, mental health problems and psychoactive medications.
Results: Adolescents with a delayed sleep phase (n=164) showed later bed and wakeup times, lower morningness scores and greater circadian phase irregularity. Cross-sectionally, a delayed sleep phase in adolescence was associated with 1.9-fold odds (95%CI=1.1–3.2) of alcohol, tobacco and/or drug use; specifically, the odds of alcohol and tobacco use associated with a delayed sleep phase were 1.9-fold (95%CI=1.1–3.4) and 2.4-fold (95%CI=1.1–5.3), respectively, while non-significant for drug use (n=28) for which mental health problems were among the strongest risk factors (OR=3.0, 95%CI=1.3–6.8). Longitudinally, an irregular circadian phase in adolescence was associated with 2.2-fold odds (95%CI=1.1–4.5) of alcohol, tobacco and/or marijuana use in young adulthood; specifically, the odds of alcohol use in young adulthood associated with an irregular circadian phase in adolescence were 1.9-fold (95%CI=1.1–3.5), while non-significant for tobacco (n=58) or marijuana use (n=76) for which mental health problems were the strongest risk factor (OR=2.2, 95%CI=1.3–3.7).
Conclusion: A delayed or irregular circadian phase in adolescence is associated with substance use, particularly alcohol use in the transition to adulthood. Beyond disturbed and insufficient sleep, circadian misalignment should become a target of early interventions to prevent substance use disorders.
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LONGITUDINAL ASSOCIATION BETWEEN NREM SLEEP DEPTH AND AROUSABILITY WITH ADHD AND INTERNALIZING DISORDERS IN ADOLESCENCE

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Introduction: Sleep depth decreases in the transition from childhood to adolescence, even in typically developing (TD) youth. However, it remains unknown whether this developmental trajectory in NREM sleep depth differs across adolescents with psychiatric/behavioral disorders.
Methods: We analyzed the sleep EEG of 392 subjects aged 5–12 at baseline and 12–22 at follow-up (45.2% female, 23.2% racial/ethnic minority), of whom 246 were TD adolescents (controls), 62 were diagnosed with a psychiatric/behavioral disorder and were taking stimulant, anti-depressant, anxiolytic, sedative and/or anti-psychotic medications, and 84 were un-medicated. NREM sleep depth was measured at both time points using the odds ratio product (ORP), which provides a standardized continuous EEG measure of NREM sleep depth/arousability (higher ORP reflects lighter NREM sleep). General linear models examined mean differences between groups on the percent change in ORP between baseline and follow-up (ΔORP) while adjusting for sex, race/ethnicity, age, BMI and AHI at follow-up, and PSG system, psychiatric/behavioral disorders, psychoactive medications and ORP at baseline as well as time-to-follow-up.

Results: Overall, medicated (80.4%, 95%CI=66.2–94.6) and un-medicated (66.1%, 95%CI=53.0–79.1) subjects showed a higher ΔORP compared to controls (52.2%, 95%CI=40.0–64.5, p<0.01 and p<0.05, respectively) but did not differ between each other (p=0.134). Specifically, un-medicated subjects with ADHD (n=56) showed a higher ΔORP (77.3%, 95%CI=62.4–92.1) compared to controls (p<0.01), while subjects with ADHD on stimulant medication (n=36) did not differ (66.1%, 95%CI=48.9–93.2) from controls (p=0.268) or from un-medicated ADHD subjects (p=0.303). Subjects with internalizing disorders on psychoactive medications (n=29) showed a higher ΔORP (104.9%, 95%CI=82.8–127.0) compared to controls (p<0.01) and to un-medicated subjects (n=27) with internalizing disorders (60.1%, 95%CI=36.8–83.3, p<0.01), who did not differ from controls (p=0.772).
Conclusion: The greater increase in ORP in the transition to adolescence in un-medicated youth with ADHD suggests that decreased NREM sleep depth may be a biomarker of the disorder. In contrast, the greater increase in ORP in medicated youth with internalizing disorders suggests that psychoactive medications impact NREM sleep depth in these children as they transition to adolescence. These data have important implications for sleep EEG studies that include medicated and un-medicated youth with comorbid psychiatric disorders.
Support (if any): NIH Awards Number R01MH118308, R01HL136587, R01HL97165, R01HL63772, UL1TR000127

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SLEEP PROBLEMS AMONG CHILDREN AND ADOLESCENTS WITH EPILEPSY IN THAILAND: SINGLE-CENTER CROSS-SECTIONAL STUDY

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Introduction: Sleep problems are common in pediatric epilepsy and may influence seizure control, daytime performance, and quality of life. The aim of this study was to investigate parent-reported and self-reported sleep problems in a sample of children and adolescents with epilepsy in Thailand.
Methods: Epileptic children age 1–18 years and their parents in epilepsy clinic completed the Phramongkutklao Hospital Sleep disorders center Questionnaire, Sleep Related Breathing Disorder- Pediatric Sleep Questionnaire (SRBD-PSQ)
Results: A total of 59 participants with the mean age of 10.8 years completed the questionnaires. The most common sleep complaint was a disorder of maintaining sleep 36 (61.01%). Several sleep manifestations were detected including disorder of initiating sleep 14 (23.7%), snoring 29 (49.2%), leg kicking 16 (27.1%), sleep talking 19 (32.2%), sleep walking 4 (6.7%), teeth gliding 18 (30.5%), nightmares 15 (25%), night terrors 8 (13.5%) and nocturnal enuresis 16 (27.1%). The frequency of sleep disordered breathing problems (SRBD-PSQ >0.33) was 33.9%.
Conclusion: The prevalence of sleep problems among children with epilepsy in Thailand is high. Therefore, a highlighting should be given to address sleep in children and adolescents with epilepsy. Further studies are needed to evaluate the effects of antiepileptic drugs, type of seizure or associated factors on sleep disruption in this population.
Support (if any): None

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LONGER SLEEP DURATION REDUCES THE ODDS OF HYPERTENSION IN CHILDREN REFERRED TO NEPHROLOGY FOR ELEVATED BLOOD PRESSURE

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Introduction: Lifestyle modification is often prescribed as first line-therapy for hypertension in childhood. We aimed to determine if there was an association between sleep duration and hypertension in children referred for evaluation to Nephrology for elevated blood pressure (BP). We hypothesized that, longer sleep duration would be associated with a reduced likelihood of a hypertension diagnosis.
Methods: Medical record data were retrospectively extracted from patients referred to the Children's Hospital of Philadelphia's pediatric nephrology clinic for the evaluation of elevated BP, without a prior hypertension diagnosis. Ambulatory blood pressure monitoring (ABPM) data collected between December 2015 to December 2018 were extracted. Hypertension was defined by ABPM according to American Heart Association recommendations for pediatric ABPM and we evaluated BP indexed to sex and height. Sleep duration was calculated as the difference between self-reported time of sleep onset and offset. Regression models were adjusted for age, sex, race, body mass index, and weeknight status.
Results: Our sample included 249 patients, with a mean age of 14.5 (SD: 3.1) years. Of these, 29% were obese and 42% met criteria for hypertension. Mean sleep duration was 9.3 (SD: 1.6) hours per night and duration was shorter with increasing age in years (β=-0.11, 95% CI: -0.18, -0.05) and on week vs. weekend nights (β=-0.62, 95% CI: -1.05, -0.24). Each additional hour of sleep was associated with lower daytime systolic BP Index Z-score (β=-0.12, 95% CI: -0.20, -0.05), lower daytime diastolic BP Index Z-score (β=-0.11, 95% CI: -0.19, -0.03) and 19% reduced odds of daytime hypertension (OR=0.81, 95% CI: 0.67, 0.98). Each additional hour of earlier timing of sleep onset was associated with lower daytime systolic BP Index Z-score (β=-0.10, 95% CI: -0.19, -0.01), lower daytime diastolic BP Index Z-score (β=-0.16, 95% CI -0.25, -0.06) and 16% reduced odds of daytime hypertension (OR=0.84, 95% CI: 0.68, 1.05).
Conclusion: In children referred for the evaluation of elevated BP, longer sleep duration and earlier sleep onset were associated with a reduced likelihood of being diagnosed with hypertension. Targeting improvements in sleep should be further investigated as part of first line therapy to treat pediatric hypertension.
Support (if any): NIH/NHLBI K01HL123612

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SLEEP SMART IN ADOLESCENTS WITH NEURODEVELOPMENTAL DISORDERS

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Introduction: Introduction: Sleep disturbances are common in adolescents with neurodevelopmental disorders (NDDs). Inclusion of vulnerable populations such as adolescents with NDDs into sleep intervention efforts is essential as they are at high-risk for poor physical/mental health outcomes. The objective of this study is to pilot a sequential, multiple assignment, randomized trial (SMART) design to compare the impact of a sequence of sleep interventions, based on treatment response, to optimize sleep health in adolescents with NDDs.
Methods: Methods: Recruitment began June 2019 using convenience sampling. The SMART pilot feasibility study includes 1-week of baseline sleep data, and two 4-week periods of a sleep intervention (9-week total study enrollment). Interventions include exogenous melatonin, The Bedtime Bank, and their combination. Exogenous melatonin (liquid, immediate release, 3mg) is administered 30 minutes before bedtime. The Bedtime Bank, a behavioral sleep intervention,

is based upon contingency contracting that relies on a credit- or debt-based system to hold adolescents accountable for maintaining a consistent bedtime. At baseline participants completed demographics, PROMIS pediatric sleep questionnaires, the Cleveland Adolescent Sleepiness Questionnaire (CASQ), salivary & urinary endogenous melatonin measurement, and one week of actigraphy. Upon enrollment, participants were randomly assigned to either melatonin or The Bedtime Bank. Participants who respond (nightly increase in total sleep time (TST) ≥18 minutes) remain on the assigned intervention; if non-responsive participants are re-randomized to a different sleep intervention or combination.

Results: Results: At baseline, participants (n=29, aged 10–18 years) had an average TST of 7 hours 11 minutes. PROMIS Sleep Disturbance (M=64.3, SE=2.5), PROMIS Sleep-Related Impairment scores (M=58.9, SE=2.2), and CASQ scores (M=40.0, SD= 10.5) were higher than reported normative values. Salivary DLMO & urinary 6-sulfatoyxmelatonin analysis is ongoing. For participants who completed the full 9-week trial, nearly 30% (n=7/24) were responsive (increased baseline TST ≥18 minutes) to one of the 4-week interventions.

Conclusion: Conclusion: Baseline data of the enrolled participants demonstrates poor indicators of TST, sleep disturbance, and sleep related impairment. Preliminary results of this SMART indicate some adolescents are responsive to sleep interventions aimed to improve their TST.

Support (if any): Support: This clinical trial is funded by the National Institute of Nursing Research, National Institutes of Health (1K01NR017465-01A1).

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FAMILY HISTORY OF CHILDREN DIAGNOSED WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Limited evidence suggests a familial association of OSA. It is not known how often children who require positive airway pressure (PAP) devices have a family member with OSA or that requires PAP. It is felt that PAP adherence in children is affected by PAP adherence in parents. We wanted to explore the relationship of OSA in children requiring PAP to OSA in immediate family members as well as the association of obesity and adherence between children and family members.

Methods: Caregivers of children who utilize PAP devices at home were invited to complete an electronic questionnaire regarding family history of OSA. Descriptive statistics were utilized to summarize results.

Results: The study was completed by 75 participants. The majority of children were male (64%, 48/75), black (47%, 35/75) and non-Hispanic (88%, 66/75). The mean age was 11.8 years (median 13) and mean BMI was 32.8 (median 29.8). The mean AHI on the diagnostic polysomnogram was 28.4 events per hour (median 15.3). Mean adherence to PAP > 4 hours per night was 56.5 (Median 68.2). Most, 87% (65/75), have other underlying medical problems. Twenty-four percent (18/75) have a biological father with OSA of whom 61% (11/18) are considered moderately/extremely obese. Of mothers, 13% (10/75) have OSA and 70% (7/10) are obese. Overall, 29% (22/75) had either a paternal (11%, 8/75) or maternal (19%, 14/75) grandfather with OSA of which 36% (8/22) are obese. For grandmothers, 31% (23/75) have OSA and 22% (5/23) are obese with more being paternal (19%, 14/75) compared to maternal (12%, 9/75). Of the 73 total family members reported to have OSA, 86% (63/73) use PAP and most (65%, 41/63) use it for > 4 hours every night. Few participants had siblings with OSA.

Conclusion: There were more fathers with OSA than mothers, but mothers were reported to be obese more often. Grandparents were reported to have OSA but were reported to be obese less often than parents. Maternal grandparents with OSA were reported to be obese more than paternal grandparents. The majority of family members with OSA who use CPAP report nightly use.

Support (if any):

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DYSREGULATED REM SLEEP IN CHILDREN WITH MOEBIUS SYNDROME

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Introduction: Moebius syndrome (MBS) is a rare disorder characterized by failure of development of the 6th and 7th cranial nerve nuclei located in the pons. Though the congenital lesion abuts the pontine tegmentum, sleep architecture has not been evaluated in MBS.

Methods: We report the clinical features of three children with MBS, and discuss implications for "developmental" RBD.

Results: Three clinically and MRI brain scan-confirmed MBS children, age 0.5 to 16 years, mean 8.5 ± 6.3 years, were evaluated for disrupted sleep, with repetitive crying (1/3), yelling (2/3), agitation in sleep (2/3), and injuring a co-sleeping sibling (1/3); 3/3 had REM sleep without atonia while 2/3 had RBD. REM sleep was reduced in all three: 21.7% in the infant (reference REM percentage value in infancy is about 40%), 11.4% in subject 2 and 3% in subject 3. Treatment with clonazepam (patients 2 and 3) or melatonin (patient 1) had variable results.

Conclusion: Children with Moebius syndrome have both quantitative (reduced percentage) and qualitative abnormalities of REM sleep (RSWA/RBD). The association of MBS with RSWA/RBD suggests more extensive involvement than published in literature, with extension into the sub-laterodorsal pontine tegmentum and "REM-off" neurons. Moebius syndrome might serve as a model for study of "developmental" REM sleep behavior disorder.

Support (if any):

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IMPACT OF CHANGING SCHOOL START TIMES ON DROWSY DRIVING AND TEEN MOTOR VEHICLE CRASHES: A LONGITUDINAL EXAMINATION

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Introduction: Early high school start times are associated with insufficient adolescent sleep, which in turn is associated with motor vehicle crashes [MVC]. This analysis examined the impact of a 70-minute delay in high school start times on student-reported drowsy driving and department of transportation MVC rates before and for 2 years after start time changes.

Methods: Self-reported sleep duration and drowsy driving data were drawn from a longitudinal study of changing high school start times (n=2099–4092/year) in the Cherry Creek School District (Arapahoe County [AC]). The Colorado Department of Transportation provided frequency/timing of weekday MVC data for teen (16–18 years) and adult drivers in AC and four neighboring counties in metro Denver (Other Counties [OC]). MVC rates per 1000 licensed drivers were calculated. Outcomes are reported for three school years: 2016–17 (pre-change), 2017–18 (post change), and 2018–19 (follow-up). Chi-square analyses examined drowsy driving frequency (at least once/week vs. less than once/week) by sufficient weeknight sleep duration (<8 hours vs. 8+ hours). Two-proportion z-tests compared MVC rates by county, as well as teens vs. adults.

Results: Compared to pre-change (29.3%), fewer students reported drowsy driving at post-change (20.3%) and follow-up (23.7%). Students who reported insufficient sleep also reported more frequent drowsy driving across all years (p's<0.001 to 0.037). AC's teen crash rate decreased from 78.9/1000 to 76.6/1000 post-change, with a further reduction to 68.7/1000 at follow-up. Pre-change crash rates did not differ between counties (p=0.444); however, they were significantly lower in AC vs. OC at both post-change (p=0.048) and follow-up (p=0.046). Adult crash rates remained consistent over three years in both counties. Morning crash rates per hour did not differ pre-change; at both post-change and follow-up OC's morning crash rates peaked one hour earlier than AC's (7:00-7:59am vs. 8:00-8:59am).
Conclusion: This study extends previous reports by finding that later school start times are associated with decreased drowsy driving and fewer teen motor vehicle crash rates for up to 2 years post-change. Early school start times is an important public policy that benefits adolescent sleep, health, and well-being through decreased drowsy driving and motor vehicle crashes.
Support (if any): Robert Wood Johnson Foundation's Evidence for Action Program

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EVENING SUNGLASSES PLUS STABLE WAKE TIMES: CAN THIS INTERVENTION HELP ADOLESCENTS WITH DELAYED SLEEP-WAKE PHASE DISORDER?

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Introduction: Evening light can increase alertness and shift the circadian clock later (delay) and, in turn, delay sleep onset timing. We are examining whether reducing evening light exposure (by wearing sunglasses) paired with stable wake times can shift circadian and sleep onset times earlier in adolescents with Delayed Sleep-Wake Phase Disorder (DSWPD).
Methods: Fifteen adolescents (14.7–18.1 years; 4 male) diagnosed with DSWPD are included in this interim analysis. Participants sleep without restriction at home for a baseline week, and then complete a 2-week intervention. One group (Amber; n=7) wears glasses with amber lenses (Cocoons®, Live Eyewear) beginning 7 hours before their baseline mid-sleep time until self-selected bedtime or for 7 hours (corresponds to the phase delay region of the adolescent phase response curve to light). The amber lens transmits 14% of light to the eye and absorbs most short wavelength light. The frame blocks light from all angles. Amber participants are also instructed to wake at their average baseline school-morning wake-up time (±30 mins). Another group (Clear; n=8) wears identical glasses with clear lenses at the same time and wake time is unrestricted. Glasses wear time is monitored with an iButton placed at the temple tip. Dim Light Melatonin Onset (DLMO) is measured after the baseline week and after the 2-week intervention; 2 participants (one from each group) do not have melatonin data due to technical error. Sleep is measured with wrist actigraphy and sleep diaries throughout the study. DLMO and sleep onset changes (baseline-intervention) are compared between groups with t-tests.
Results: Amber DLMOs shifted 1.0±2.0h earlier (min-max: 0.4-h delay-5.0-h advance) and Clear DLMOs shifted 0.4±1.1h later (min-max: 2.0-h delay-0.6-h advance) [t(11)=1.60,p=0.14]. Average school-night sleep onset shifted earlier in both groups (Amber:0.4±1.3h; Clear:0.6±1.0h; t(13)=0.2,p=0.8]. Average non-school-night sleep onset shifted 1.1±1.0h earlier in Amber (min-max:0.6-h delay-2.2-h advance) and remained stable (0.03±1.0h) in Clear (min-max: 1.8-h delay-1.7-h advance) [t(13)=1.92,p=.08].
Conclusion: Trends from this ongoing study suggest that amber-lensed glasses to block evening light plus stable wake-up times may shift circadian rhythms earlier. This strategy appears to help adolescents with DSWPD fall asleep earlier predominantly on non-school nights.
Support (if any): AASMF Strategic Research Award (184-SR-17) to RRA

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ASSOCIATIONS AMONG SLEEP, PHYSICAL ACTIVITY AND HIGH BODY MASS INDEX IN YOUTH: AGE DIFFERENCES

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Introduction: Short sleep duration is associated with overweight and obesity. Less clear is how sleep regularity and physical activity interact with sleep duration in predicting overweight across adolescent stages. This study examined interactions between (1) sleep duration and regularity, and (2) sleep duration and physical activity on overweight in preadolescents (10–11 years), early (12–14), and middle (15–17 years) adolescents.
Methods: Using the National Survey of Children's Health 2017–2018 dataset, we included youth with sleep, physical activity and overweight data available (n=25,875) in the analyses. Parents reported their children's sleep duration, sleep regularity and physical activity (>60 min/day) frequency per week. High Body Mass Index (BMI, ≥85th percentile) for age and sex indicated overweight/obesity. Accounting for complex survey design and covariates (age, sex, race, poverty, and resilience), separate logistic regression models (STATA 16.0) estimated the associations in preadolescents, early and middle adolescents.
Results: Preadolescents had the highest odds of high BMI compared to other age groups (OR= 0.64 and 0.78, p<0.001). Every hour increase in sleep duration was associated with 4–18% decrease in the odds of having high BMI, with the highest magnitude shown in preadolescents (OR=0.82, p<0.001), followed by adolescents aged 12–14 (OR=0.89, p<0.001) and 15–17 years old (OR=0.96, p=0.04). For preadolescents, irregular sleep (OR=1.41, p<0.001) and physical activity (OR=0.83, p=0.03) modified the association between sleep duration and BMI. Specifically, the association was attenuated or even reversed among irregular sleepers (OR=1.09, p=0.27) compared with regular sleepers (OR=0.77, p<0.001). Preadolescents with regular physical activity (≥4 days/week) showed stronger associations (OR=0.74, p<0.001) between sleep duration and BMI than their counterparts (OR=0.89, p=0.01). Sleep regularity was not associated with BMI nor a modifier in other age groups. Although there was no interaction with sleep duration, regular physical activity was independently associated with decreased odds of having high BMI (OR=0.62, p<0.001) in early and middle adolescents.
Conclusion: The relationship between lifestyle factors (i.e., sleep duration and physical activity) and BMI varies by age groups. Sufficient sleep duration, regular bedtimes and physical activity represent resilience factors against overweight/obesity, especially in preadolescents who are at greater risk for high BMI.
Support (if any): N/A

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CUMULATIVE RISK ASSOCIATED WITH POOR SLEEP HEALTH IN CHILDREN AND ADOLESCENTS

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Introduction: Social risk factors are associated with poor sleep outcomes across the life course. It is unclear if this association varies based on biological factors, such as age and gender. Therefore, the purpose of this analysis was to identify if age or gender moderated the association between cumulative risk and sleep duration/regularity in a national sample of children and adolescents.
Methods: We completed a secondary data analysis using the National Survey of Children's Health 2017–2018 publicly available dataset. In a sample of 36,997 children age 6–17 years, we explored the association between a social cumulative risk index score (CRI) and child sleep duration and regularity. We included eight dichotomous social risk variables in the CRI: parental education
Results: Age was a significant moderator of the association between CRI and short sleep duration, such that the magnitude of the CRI-sleep relationship was greater in school-age children (age 6–11; b = -0.13, p<0.001) compared to adolescents (age 12–17 years; b = -0.05, p<0.001). Age was not a significant moderator between CRI and sleep irregularity. However, CRI independently predicted increased odds of sleep irregularity (OR = 1.30, p<.001) and older age moderately increased the odds of sleep irregularity (OR = 1.21, p = 0.06). Sex was not a significant moderator of the association between CRI and sleep duration or sleep regularity. However, female sex was positively associated with sleep duration (b = 0.06, p = 0.11), but was not a significant independent predictor of sleep irregularity.
Conclusion: Younger children with cumulative risk factors are at risk for short sleep duration. Further research is needed to uncover biological mechanisms underlying multiple sleep parameters across developmental ages.
Support (if any):

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SLEEP AND CIRCADIAN MARKERS OF BMI IN A DIVERSE SAMPLE OF 9-YEAR OLD CHILDREN FROM THE FRAGILE FAMILIES CHILD AND WELLBEING STUDY

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Introduction: Hispanic and Black school-age children from low-income communities experience disproportionate rates of obesity (26% Hispanic, 22% Black) compared to their White counterparts (14%). Sleep patterns and circadian regulation of biological markers are associated with BMI status. However, little is known about racial and ethnic disparities in circadian regulation among children of color. These suggest that it is important to investigate biological markers that could help delineate associations between sleep-circadian regulation and obesity among children of color. Serotonin transporter gene, a neurotransmitter associated with circadian rhythm regulation, has emerged as an important biological variable. In this study, we investigated whether this factor could serve as a proxy for studying associations of circadian rhythm regulation with weight status in this diverse sample.
Methods: Statistical analysis included descriptive and linear regression analysis of the wave 5, Year 9 cohort of the Fragile Families Child and Wellbeing Study dataset. Interviews were conducted with the participant child around their ninth birthday for data collection on home routines and other parent relationship and school connectedness variables. Biological variables were derived from saliva samples at Year 9 to assess telomere length and DNA methylation levels and changes. Variables of interest included sleep duration, sleep timing, and biological variables 5httlpr (insomnia and sleep quality), skin 2 (serotonin transporter), telomere length (stress) and rs9939609 (fat mass and obesity), with BMI as the outcome.
Results: The final sample of 466 children comprised 52% male were 9 years old. Participants' race was: 35% White, 46% Black, 20% Hispanic, 4% Asian and 5% other. Median family income was $42,500. Sleep duration obtained from these children was negatively associated with BMI (β = -0.245 with p=0.022). We found that gk5stin212 (serotonin transporter gene) was positively associated with BMI (β = 0.991, p = 0.009), while no significant associations was found for genetic variable gk5stin210.
Conclusion: Circadian rhythm dysregulation may serve as a biological mechanism driving overweight or obesity among minority children. Lifestyle and behavioral interventions aimed at the family unit may be needed to modify household and environmental factors that affect circadian regulation among children.
Support (if any): NIH (T32HL129953), K07AG052685, R01MD007716, R01HL142066, K01HL135452, R01HL152453

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AN EXPLORATORY STUDY OF PARENTS-CHILD CO-SLEEPING IN KOREA

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Introduction: Asian cultures, including Korea, are known to have a higher proportion of parent-child co-sleeping than Western cultures. While recent studies have shown that bed-sharing increases the mother's depression and causes sleep problems for children, there has never been a study in Asia on the sleep problems of parents and children caused by co-sleeping. Therefore, we aim to investigate the types of sleep problems in children and their mothers' insomnia severity due to co-sleeping.
Methods: This study was conducted in 79 mothers (mean age 33.65 ±3.98 years) who reported having insomnia due to their children. All participants had children between 6 to 36 months old. Participants were asked to answer the survey includes demographics, sleep environment, child's sleep problems, child's health status items and the mother's insomnia (measured by the Insomnia Severity Index; ISI). Children's age was divided into 5 age groups (6 – 11, 12 - 17, 18 - 23, 24 - 29, and 30 to 36 months). Frequency analysis and independent t-test were conducted.
Results: Of the total respondents, 72.2% (n=57) reported co-sleeping with their children. The most reported sleep problem in children was waking up in the middle of the night 51.9% (n=41), followed by difficulty in sleep initiation 12.7% (n=10), looking for mother or an attachment object 12.7% (n=10), sleep-limiting problems 7.5% (n=6), multiple problems 12.7% (n=10), and none 2.5% (n=2). An independent t-test results for determining whether co-sleeping caused a difference in the severity of maternal insomnia was significant in the 6 to 11 months group only (t=-2.336, p<.05). The co-sleeping mother's ISI average score (M=18.28) was significantly higher than mother who slept separate from her child (M=14.31).
Conclusion: Co-sleeping in Asian cultures is prevalent, and may require attention and intervention for mothers who report having insomnia due to their children's sleep disturbance.
Support (if any):

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REGULAR BEDTIME ROUTINES AND BIOLOGICAL OBESITY RISK AMONG 9-YEAR OLD CHILDREN FROM THE FRAGILE FAMILIES CHILD AND WELLBEING STUDY

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Introduction: Obesity rates among Hispanic (26%) and Black (22%) children are considerably higher compared to their white counterparts (14%), which evidence suggests may be attributable to biological, behavioral, and psychosocial factors affecting the family unit. Bio-behavioral factors in the household may affect child health behaviors, including sleep, a known predictor for obesity. Hispanic and Black children report shorter sleep duration, later bedtimes, and are often lacking in bedtime routines, compared to white children. Evidence suggests that early childhood routines are highly predictive of overweight status in children. Herein, we investigate whether bedtime routines are associated with the genetic allele for obesity in a racially diverse sample of children.
Methods: Data for the present analysis emanated from wave 5 (Year 9--2007–2010) cohort of the Fragile Families Child and Wellbeing Study dataset. During home visits, interviews with children's mother and father during home visits, around the target child's ninth birthday collected data on home routines and other parent-child relationship and school connectedness topics. Saliva samples were also collected at Year 9 to assess telomere length and DNA methylation levels and changes. The independent variable was regular bedtime routine, and biological variable for fat mass and obesity (rs9939609) was the dependent variable. Adjusted covariates included child's age and BMI, and parent household income.
Results: Analysis of the final sample of 466 children showed 52% of the children were male and were 9 years old, on average; 35% were White, 46% Black, 20% Hispanic, 4% Asian and 5% other. The median family income was $42,500. The child's sleep measures captured was 'children have a regular bedtime routine' was associated with ($\beta = -0.137$, $p = 0.01$) decrease in the odds of having the genetic allele for obesity.
Conclusion: Regular bedtime routines among 9-year old Black and Hispanic children may be associated with genetic alleles related to fat mass and obesity. Regular bedtime routines could aid in promoting healthy weight in children.
Support (if any): NIH (T32HL129953, K07AG052685, R01MD007716, R01HL142066, K01HL135452, R01HL152453.

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THE STATUS OF LIFE SATISFACTION AND PHYSICAL STRESS EXPERIENCE AMONG CHILDREN WITH SLEEP RELATED ISSUES: PROMIS APPROACH

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Introduction: To identify the status of health-related quality of life (HR-QoL) domains in children with sleep disturbance.
Methods: Patients ages 5–17 years visiting sleep laboratory from 09/2019 to 01/2020 for overnight PSG participated in the study. Age and sex matched control participants were seen in general pediatrics during 02/2020 for issues other than sleep disturbance. HR-QoL was assessed by PROMIS V1.0 questionnaires. Statistical analysis was conducted using R 3.6.0.
Results: 122 patients were included in the final analysis: 70 males (57.4%). Ninety nine (81.15%) patients were included from the sleep laboratory and 23 (18.85%) controls were recruited from the department of pediatrics. Among the patients visiting sleep laboratory, thirty one (25.4%) had mild OSA, 12 (9.8%) moderate OSA, 19 (15.6%) severe OSA, 37 (30.3%) were diagnosed with No-OSA. Twenty three (18.9%) controls were visiting to the hospital for their routine wellness examination requiring no PSG. Severity of OSA was not correlated with any HR-QoL domain. Patients visiting the sleep laboratory had lower life satisfaction ($p=0.05$) and higher physical stress experience ($p=0.005$). Age, BMI were negatively and N3 sleep was positively associated with family relations ($p<0.001$, 0.03, 0.006, respectively). N3 sleep was positively and age was negatively associated with life satisfaction ($p<0.001$, $p=0.003$, respectively). Increase in arousals was associated with increased physical stress experience ($p=0.03$). N3 sleep and anger were negatively associated with each other ($p=0.05$).
Conclusion: Children visiting sleep laboratory had higher physical stress experience and lower life satisfaction as compared to controls. Deep sleep was associated with problems with family relations, life satisfaction and anger. Regression analysis suggested that age was negatively associated with family relations and life satisfaction.
Support (if any): None

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A SCHOOL-BASED HEALTH AND MINDFULNESS CURRICULUM IMPROVES CHILDREN'S OBJECTIVELY MEASURED SLEEP

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Introduction: Children of low socioeconomic status (SES) experience shorter sleep duration and poorer sleep quality, as well as more daytime sleepiness, compared to children of higher SES. Early interventions teaching skills for managing stress may mitigate the effects of SES-associated stress on trajectories of physical and mental health. We examined effects of a school-based health and mindfulness curriculum, teaching stress management skills such as paced breathing, on sleep and stress in school-aged children. We hypothesized curriculum exposure would improve children's ability to manage stress, and that this would improve objectively measured sleep (i.e., increase duration of total and REM sleep).
Methods: Using a prospective observational cohort design, we recruited 115 children (49 girls, ages eight to 11) from two Northern California school districts. Of these, 58 children attended a school district that delivered a health and mindfulness curriculum twice weekly during their physical education time. 57 children attended an SES-matched school district that delivered a traditional physical education curriculum. Ambulatory polysomnography and perceived social stress were measured at baseline (before curriculum exposure) and at one- and two-year follow-ups.
Results: Children receiving the curriculum gained an average of 74 minutes of total sleep and 24 minutes of rapid eye movement (REM) sleep per night during the two-year study period. Children not receiving the curriculum experienced a decrease in total sleep of 64 minutes per night, with no changes in REM sleep. Sleep improved within the first three months of curriculum exposure. Children who reported higher curriculum engagement (e.g., using the breathing exercises at home) experienced larger changes in sleep architecture and perceived social stress. Social stress did not mediate effects of the curriculum on sleep.
Conclusion: We conducted the first study to examine effects of a school-based health and mindfulness curriculum on children's objectively measured sleep. Children from a low-SES community who received the curriculum experienced increased total and REM sleep, compared to an SES-matched cohort not receiving the curriculum. Mindfulness training may have increased awareness of stress, while developing tools to reduce stress vulnerability. These results warrant additional investigation to assess whether benefits persist after curriculum cessation and/or generalize to other populations.
Support (if any):

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REST ACTIVITY RHYTHMS, SYMPTOM BURDEN, AND GLUCOSE VARIABILITY IN YOUNG ADULTS WITH TYPE 1 DIABETES

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Introduction: Circadian alignment is an important element in individual health, and one behavioral marker, rest-activity rhythm (RAR), may influence disease management in young adults with type 1 diabetes (T1D). Thus, in this descriptive study, we examined whether circadian rhythm is correlated with symptoms (emotional and diabetes distress, and diabetes physical symptom burden) and glucose variability in young adults with T1D.

Methods: Using convenience sampling, young adults with T1D underwent concurrent actigraphy and continuous glucose monitoring for 6–14 days to generate the following RAR parameters: (MESOR, amplitude, acrophase, and circadian quotient) and glucose variability indices (coefficient of variation and time in range). Participants completed the 8-item Epworth Sleepiness Scale, 8-item PROMIS v1.0 Emotional Distress Scale, 17-item Diabetes Distress Scale, and 34-item Diabetes Symptom Checklist-Revised. Cosinor analysis was used to compute the RAR parameters and linear regression modeling procedures were performed to determine the associations among the study variables.

Results: The sample included 46 young adults (mean age 22.3±3.2; 32.6% male; 84.8% non-Hispanic White, A1C mean 7.2±1.1%, BMI 27.0±4.4 kg/m2). A more robust rhythm (higher amplitude) was associated with a lower diabetes symptom burden (ß=-0.31, p=.035). A higher circadian quotient was associated with less daytime sleepiness (ß=-0.41, p=.004). All associations between the RAR parameters and symptom measures remained statistically significant (p<.05) after adjustment for sex and BMI. The associations between the RAR parameters and glucose variability indices were not significant.

Conclusion: RAR was associated with daytime sleepiness, as well as symptom burden in young adults with T1D even after consideration of sex and BMI. Future investigators should clarify the causality of these associations and the potential for improving the strength and stability of RAR in the mitigation of daytime sleepiness and symptoms.

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SLEEP QUALITY IN INTENSIVE CARE UNIT PATIENTS WITH ADVANCED HEART FAILURE

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Introduction: Around 75% of Americans with heart failure (HF) report poor sleep quality, a much higher percentage than the general population. This is especially concerning since poor sleep quality is associated with poor cardiac event-free survival. Persons with HF are hospitalized often and between 10–51% of those hospitalized are admitted to an intensive care unit ICU. Poor sleep quality is a common complaint in ICU with over 50% of patients rating sleep quality as poor to very poor. The purpose of the study was to evaluate changes in sleep quality in persons with advanced HF who were admitted to an ICU.

Methods: Persons with advanced HF admitted to ICU were recruited into this pilot study (age 29–89). Using the Pittsburgh Sleep Quality Index, self-reported sleep quality was assessed at three time points: pre-admission, during hospitalization, and post-discharge. Scores greater than five indicated poor sleep quality. A Repeated Measures Analysis of Variance (RMANOVA) test compared means from the same participant over time for sleep quality (N=22).

Results: At baseline, 93% of participants reported poor sleep, 90% during hospitalization, and 86% post-discharge. A significant difference among the three time points was found [F (2, 42) =5.341; p<.01]. The mean sleep quality score pre-admission was 11.77 and SD=3.69, during hospitalization M=12.27 and SD=3.65, and post-discharge M=9.32 and SD=4.56. The mean difference of sleep quality pre-admission and sleep quality during hospitalization was not significant. However, the mean difference of sleep quality pre-admission and sleep quality post-discharge was significant (Mean difference=2.46; p<.05). Also, a significant difference in sleep quality during hospitalization and post-discharge was found (Mean difference=2.96; p<.05).

Conclusion: The number of participants who reported poor sleep during hospitalization was much larger than previously reported in the literature. Also, participants reported significantly better sleep quality post-discharge than pre-admission and during hospitalization. Furthermore, this population may be vulnerable for poor sleep due to symptom severity prior to hospital admission, diuretic use, and poor sleep hygiene. Implementation of sleep hygiene strategies are needed during hospitalization to promote sleep and to teach sleep hygiene self-management.

Support (if any):

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ACUTE INSOMNIA DISORDER IN HEALTH CARE WORKERS BEFORE AND DURING COVID-19: RATES AND PREDICTIVE FACTORS

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Introduction: Pandemics such as COVID-19 create population-wide stressors that create a natural laboratory for acute insomnia research. This study investigated risk factors and estimated rates of acute insomnia disorder in health care workers at the onset of the COVID-19 pandemic.

Methods: A Qualtrics survey of more than 2300 health care providers was conducted in a single academic health system on May 15th 2020, comprised of practicing attending physicians, residents and fellows in training, advanced practice providers, and nurses. Six hundred and sixty eight responded (29% response rate). The Research Diagnostic Criteria for Insomnia Disorder was used to diagnose Acute Insomnia Disorder.

Results: 573 respondent had no missing data pertaining to sleep, with a mean age of 43.4 + 12.5 years and 72% women. The rate of Insomnia Disorder before COVID-19 was 44.5%, while after COVID-19 it was 64.0% - a statistically significant increase. 10.2% of persons with Insomnia Disorder before COVID-19 stated it had resolved during COVID-19, while 43.4% of persons who did not have Insomnia Disorder before COVID-19 developed Acute Insomnia Disorder during COVID-19 ($\chi 2$=145.2; df=1; P<0.0001). New cases of Acute Insomnia Disorder increased with female gender, advancing age, and less time spent in direct patient care.

Conclusion: Insomnia Disorder showed high baseline prevalence before COVID-19, followed by a striking increase in incidence in this sample of tertiary care health care workers. The effects of gender and age were similar to what has been previously published as risk factors for insomnia. The surprising finding that less time spent in direct patient care was associated with more cases of Acute Insomnia Disorder might be related to the poorly understood stresses of working from home during COVID-19.
Support (if any):

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THE IMPACT OF THE COVID-19 PANDEMIC ON NIGHTTIME ROOM ENTRIES AND SLEEP DISRUPTIONS FOR PEDIATRIC PATIENTS

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Introduction: Sleep is critical to children's health and recovery, but pediatric inpatient sleep is often disrupted by nonessential overnight interruptions. The COVID-19 pandemic necessitated social distancing policies which minimized contact with low-risk patients. These policies have the potential to decrease overnight disruptions and improve sleep for hospitalized patients.
Methods: This cohort study compared sleep disruptions for pediatric inpatients admitted prior to (Sep 2018 – Feb 2020) and during (Apr 2020 – Aug 2020) the COVID-19 pandemic at a single site, urban academic medical center. Objective disruptions were measured as room entries detected by hand hygiene sensors for occupied rooms pre-pandemic (n_average=56) and during the pandemic (n_average=48) for 69 and 154 nights, respectively. Subjective reports of overnight disruptions, sleep quantity, and caregiver mood were measured by surveys adopted from validated tools: the Karolinska Sleep Log, Potential Hospital Sleep Disruptions and Noises Questionnaire, and Visual Analog Mood Scale. Caregivers of a convenience sample of pediatric general medicine inpatients completed surveys. Caregivers pre-pandemic were surveyed in person, and during the pandemic, surveys were conducted over the phone.
Results: 293 pre-pandemic (age_patients=4.1±4.4 years) and 154 pandemic (age_patients=8.7±5.6 years) surveys were collected from caregivers. The majority (71% pre-pandemic and 52% pandemic) of the study population identified as Black/African American. Nighttime room entries initially decreased 36% (95% CI: 30%, 42%, $p<0.001$), then returned towards pre-pandemic levels as the COVID-19 hospital caseload decreased. Despite this, caregivers reported more disrupted patient sleep ($p<0.001$) due to tests (21% vs. 38%) as well as stress (30% vs. 49%), anxiety (23% vs. 41%), and pain (23% vs. 48%). Caregivers also reported children slept 61 minutes less (95% CI: 12 min, 110 min, $p<0.001$) and had more awakenings. Caregivers self-reported feeling more sad and weary, less calm, and worse overall ($p<0.001$ for all).
Conclusion: Despite fewer objective room entries, caregivers reported increased sleep disruptions and an hour less nighttime sleep with more awakenings during the pandemic for pediatric patients. Caregivers also self-reported worse mood. This highlights the importance of addressing subjective perceptions and experiences of hospitalized children and their caregivers during hospitalization.
Support (if any):

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ADOLESCENT AND YOUNG ADULT SLEEP AND SLEEP-RELATED BEHAVIOUR CHANGE DURING THE COVID-19 PANDEMIC

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Introduction: Sleep disturbance, poor sleep quality, and dissatisfaction with sleep are common among adolescents and young adults (AYAs; e.g., Becker et al., 2018; Hicks et al., 2002; Hysing et al., 2013). Environmental and behavioural factors (e.g., early school start times, evening technology use and social pressures) are barriers to healthy sleep among AYAs that contribute to a "perfect storm" of sleep disturbance during this period (Carskadon, 2011; Crowley et al., 2018). Notwithstanding, few AYAs have access to sleep treatments. The COVID-19 pandemic lockdowns decreased academic and scheduling demands, providing an opportunity to study unconstrained AYA sleep and potentially facilitating better access to sleep interventions (Simpson & Manber, 2020). This study evaluated differences in baseline sleep and sleep-related behaviour change (i.e., how AYAs use an evidence-based app for sleep disturbance) before vs. during the lockdown.
Methods: Participants between the ages of 15 and 24 (M=20.66, SD=2.38) completed a 4-week feasibility study evaluating a free, transdiagnostic sleep self-management app (DOZE) before the lockdown ("Pre-Lockdown"; n=51) or during the lockdown ("Lockdown"; n=29). After 2 weeks of completing baseline sleep diaries, participants could set goals based on feedback and access tips, followed by 2 more weeks of completing sleep diaries.
Results: Compared to Pre-Lockdown, Lockdown demonstrated less variability in their sleep schedules (ps≤.011), less napping (p=.002), but increased time in bed (TIB; p<.001) and total wake time (p=.007). Total sleep time, lingering in bed in the morning, and sleep efficiency did not differ between groups. Relative to Pre-Lockdown, Lockdown showed a greater tendency to set goals to reduce schedule variability (p=.010) and to restrict excessive TIB (p=.005). Rates of goal setting for lingering in bed in the morning, sleepiness, naps, and sleep-interfering substance use did not differ between groups. Rates of accessing tips did not differ between groups.
Conclusion: Effects of COVID-19 lockdown on AYA sleep included less variability in their schedule and a decreased need for naps, but negative effects on TWT and TIB. As a result, AYAs set different goals during the COVID-19 lockdowns, focusing more on restricting excessive TIB than on schedule variability.
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ASSOCIATIONS BETWEEN OBJECTIVE AFTERNOON AND EVENING PHYSICAL ACTIVITY AND POLYSOMNOGRAPHIC SLEEP IN FIBROMYALGIA

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Introduction: Patients with fibromyalgia (FM) suffer from pain which limits physical activity and disrupts sleep. Research examining the relationship between pre-bedtime physical activity, pain, and objective sleep is limited. This study examined whether objectively measured activity levels (via actigraphy), pain intensity, or their interaction are associated with polysomnographic sleep outcomes and sleep architecture.
Methods: Adults with FM (n=158, Mage=52, SD=12, 93% female) completed 14 daily pain ratings, 14 days of actigraphy, and a single night of polysomnography. Activity levels (i.e., magnitude of wrist motion captured per 30 second epoch) were recorded, and average afternoon/evening activity for intervals 12:00-15:00, 15:00-18:00, and 18:00-21:00 was computed, removing days in which participants slept during these periods. Sleep architecture was quantified as the percentage of sleep time in rapid eye movement (%rem) and non-rem (i.e. %stage 1, %stage 2, and %stage 3). Multiple regressions examined

whether average afternoon/evening activity, average evening pain [0 (no pain)–100 (most intense pain imaginable)], or their interaction predicted polysomnographic sleep onset latency (SOL), wake after sleep onset (WASO), sleep efficiency (SE), %stage 1, %stage 2, %stage 3, and %rem, controlling for age, body mass index, average individual bedtime, time in bed, and sleep or pain medication usage.
Results: Greater afternoon activity from 12:00-15:00 was independently associated with lower SE (B= -.08, p=.01), greater WASO (B=.45, p<.001), and greater %stage 1 (B=.04, p<.01). Pain intensity interacted with physical activity from 12:00-15:00 such that the association between physical activity and higher WASO (p=.05) and greater %stage 1 (p<.01) was stronger for individuals with higher pain. Pain intensity and activity from 15:00-18:00, and 18:00-21:00 were not associated with sleep outcomes.
Conclusion: Our results suggest greater afternoon activity is associated with greater polysomnographic sleep fragmentation and greater %stage 1 sleep in FM, and these relationships are stronger for individuals with higher pain. These relationships are consistent with activity pacing recommendations for chronic pain and suggest pacing in the afternoon may be important for good sleep in FM. However, future research examining causal pathways linking physical activity levels and timing, pain, and sleep is needed.
Support (if any): Support: NIAMS (R01AR055160/R01AR005160-S1;PI McCrae). Data collected at University of Florida (Clinical Trial-NCT02001077;PI McCrae).

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COPING STRATEGIES MODERATE THE EFFECT OF PERCEIVED STRESS ON SLEEP AND HEALTH IN OLDER ADULTS DURING THE COVID-19 PANDEMIC

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Introduction: The COVID-19 pandemic is an enormous stressor that can impact various dimensions of health, including sleep health. Older adults may be particularly vulnerable. Coping strategies to manage stress can also impact health outcomes by modifying the relationships between perceived stress and health outcomes. This study examined concurrent and longitudinal associations between perceived stress and sleep health, mental health, physical health, and overall perceived health outcomes among older adults. We also examined whether coping strategies moderate these associations.
Methods: Older adults (n = 115; Mage = 68.62, 58.3% female) reported perceived stress (PSS), coping strategies (Brief COPE), global sleep quality (PSQI global sleep quality score and dichotomous good/poor sleep quality), depressive symptoms (CES-D), and perceived mental, physical, and overall health (RAND-12) before and during the COVID-19 pandemic.
Results: The number of individuals with poor sleep quality was greater during the COVID-19 pandemic than before (50% vs. 36.5%). Participants also reported poorer physical health during the COVID-19 pandemic than before. Hierarchical linear regression and hierarchical logistic regression revealed that higher perceived stress was cross-sectionally associated with poorer sleep (e.g., higher total PSQI score and dichotomous sleep quality category). Higher perceived stress was associated with worse depressive symptoms and global mental health concurrently and longitudinally. Coping strategies moderated the relationships between perceived stress and physical health and overall perceived health. For example, higher perceived stress was associated with poorer overall perceived health for those who have lower problem-focused coping—but not for those with higher problem-focused coping—both concurrently and longitudinally.
Conclusion: Perceived stress influences cross-sectional and longitudinal measures of sleep health and general health among older adults during the COVID-19 pandemic. Coping strategies can moderate the effects of perceived stress on health outcomes. Older adults may benefit from prevention and intervention strategies targeting stress management and problem-focused coping strategies.
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THE ASSOCIATION BETWEEN SLEEP AND PSYCHOLOGICAL DISTRESS AMONG NEW YORK HEALTHCARE WORKERS DURING THE COVID-19 PANDEMIC

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Introduction: Healthcare workers (HCWs) treating patients with COVID-19 report high rates of acute stress, depressive and anxiety symptoms. We examined whether sleep disturbances were associated with psychological distress in New York City (NYC) HCWs during the initial peak of COVID-19 in-patient admissions (April 9 - May 11, 2020).
Methods: HCWs (physicians, nurses, and advanced practice providers) completed a web-based survey which screened for acute stress (4-item Primary Care PTSD screen), depressive symptoms (Patient Health Questionnaire-2), and anxiety (2-item Generalized Anxiety Disorder scale). Past week insomnia symptoms were assessed with a modified item from the Insomnia Severity Index (5-point Likert Scale: none, mild, moderate, severe, very severe). Insomnia was defined as having "moderate, severe, or very severe" symptoms. Short sleep (SS) was defined as self-reported sleep duration <6 hours per day. Poisson regression analyses predicting psychological distress from SS and, separately insomnia. adjusting for age, gender, race/ethnicity, clinical setting (COVID-focused or not COVID-focused), physician vs. non-physician status, and redeployment status, were performed.
Results: Data included 813 HCWs (80.6% female, 59.0% White, 75.6% worked in a COVID-focused setting). Mean sleep duration was 5.79 ± 1.22 hours/night. The prevalence of SS and insomnia were 38.8% and 72.8%; the prevalence of acute stress, depressive symptoms, and anxiety were 57.9%, 33.8% and 48.2%, respectively. Having SS, vs. not was associated with acute stress (adjusted prevalence ratio [PR]: 1.21, 95% CI: 1.07, 1.31), depressive symptoms (PR: 1.65, 95% CI: 1.35, 2.02), and anxiety (PR: 1.51, 95% CI: 1.30, 1.74). Presence of insomnia symptoms vs. "none or mild" was associated with acute stress (PR: 1.92, 95% CI: 1.57, 2.34), depressive symptoms (PR: 3.13, 95% CI: 2.16, 4.52), and anxiety (PR: 2.40, 95% CI: 1.86, 3.11).
Conclusion: Among NYC HCWs, sleep disturbances, including SS and insomnia symptoms during COVID-19 are common. In our study, SS and insomnia were associated with acute stress, depressive symptoms, and anxiety in HCWs, however further research on whether a bi-directional relationship exists between sleep and psychological distress during the COVID19 pandemic are still needed.
Support (if any):

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LONGITUDINAL, UNOBTRUSIVE, AND ECOLOGICALLY VALID SLEEP METRIC ESTIMATION FROM A SMART BED TO PREDICT THE PATHOLOGY OF COVID-19

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Introduction: Pathophysiologic responses to viral respiratory challenges such as SARS-CoV-2 may affect sleep duration, quality and concomitant cardiorespiratory function. Unobtrusive and ecologically valid methods to monitor longitudinal sleep metrics may therefore have practical value for surveillance and monitoring of infectious illnesses. We leveraged sleep metrics from Sleep Number 360 smart bed users to build a COVID-19 predictive model.
Methods: An IRB approved survey was presented to opting-in users from August to November 2020. COVID-19 test results were reported by 2003/6878 respondents (116 positive; 1887 negative). From the positive group, data from 82 responders (44.7±11.3 yrs.) who reported the date of symptom onset were used. From the negative group, data from 1519 responders (48.4±12.9 yrs.) who reported testing dates were used. Sleep duration, sleep quality, restful sleep duration, time to fall asleep, respiration rate, heart rate, and motion level were obtained from ballistocardiography signals stored in the cloud. Data from January to October 2020 were considered. The predictive model consists of two levels: 1) the daily probability of staying healthy calculated by logistic regression and 2) a continuous density Hidden Markov Model to refine the daily prediction considering the past decision history.
Results: With respect to their baseline, significant increases in sleep duration, average breathing rate, average heart rate and decrease in sleep quality were associated with symptom exacerbation in COVID-19 positive respondents. In COVID-19 negative respondents, no significant sleep or cardiorespiratory metrics were observed. Evaluation of the predictive model resulted in cross-validated area under the receiving-operator curve (AUC) estimate of 0.84±0.09 which is similar to values reported for wearable-sensors. Considering additional days to confirm prediction improved the AUC estimate to 0.93±0.05.
Conclusion: The results obtained on the smart bed user population suggest that unobtrusive sleep metrics may offer rich information to predict and track the development of symptoms in individuals infected with COVID-19.
Support (if any):

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ASSOCIATION BETWEEN POOR SLEEP AND LYMPHOCYTE SUBSETS IN CHRONIC HIV INFECTION

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Introduction: Low CD4+ T lymphocyte counts and CD4+/CD8+ lymphocyte ratios predict mortality and cardiovascular risk among people living with HIV (PLWH). Whether polysomnographic (PSG) sleep measures impact T lymphocyte subset counts among PLWH is unknown. We sought to evaluate the association between lymphocyte subsets and PSG-derived sleep measures in a cohort with HIV seropositive men.
Methods: We analyzed data from HIV seropositive men who have sex with men participating in the Multicenter AIDS Cohort Study on antiretroviral therapy for >1 year with undetectable (<500 copies/mL) plasma HIV-1 RNA who underwent a sleep evaluation with home polysomnography. The following seven sleep parameters were examined: total sleep time (TST), sleep efficiency, sleep stage (N1, N2, N3, and REM) duration, and apnea-hypopnea index. Multivariable linear regression models adjusted for age and body mass index were used to assess whether sleep measures were associated with CD4+ T cell count, CD8+ T cell count, or CD4+/CD8+ ratio.
Results: Participants (n= 286) had a mean age of 55.2 ± 11.3 years, 52.8% had sleep apnea and mean CD4+ count was 728 ± 306 cells/mm3. None of the sleep measures were associated with CD4+ counts but longer TST and REM duration were associated with lower CD8+ counts and higher CD4+/CD8+ ratio. In adjusted analyses, every one hour increase in TST was associated with a 35 ± 18 cells/mm3 lower CD8+ count (p=0.049) and 6.3% elevation in CD4+/CD8+ ratio (p=0.006) while every hour increase in REM was associated with 123 ± 50 cells/mm3 lower CD8+ count (p=0.01) and 20% elevation in CD4+/CD8+ ratio (p=0.003).
Conclusion: In PLWH, longer total sleep time and REM sleep duration are associated with protective CD4+/CD8+ ratios due to lower CD8+ cell count. Further research is needed to assess if longer sleep duration is associated with decreased inflammatory markers.
Support (if any): American Thoracic Society Academic Sleep Pulmonary Integrated Research/Clinical (ASPIRE) Fellowship

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ARE DAILY VARIATIONS IN SLEEP QUALITY AND QUANTITY RELATED TO GENERAL STRESS AND COVID-19-RELATED ANXIETY?

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Introduction: Sleep modulates a number of psychological and cognitive processes, such as emotion regulation, executive control, and coping with stress. It is therefore not surprising that insufficient sleep quality or quantity are associated with greater self-reported stress levels. The COVID-19 pandemic has led to a particularly stressful and unprecedented time in history. While stress has been undoubtedly high during the past year, it's less clear to what extent sleep has affected people's perceived stress on a daily basis. The aim of this research was to estimate whether daily variations in sleep quality and duration were associated with general stress and/or stress related to COVID-19.
Methods: The study used a nationally representative sample to assess daily variations in sleep and stress for a period of two weeks during the COVID-19 pandemic. Morning assessments were conducted using online sleep diaries. These diaries were used to estimate sleep duration (in minutes) and sleep quality (subjective rating on a 5-point Likert scale). Evening assessments were also completed online and prompted participants to rate (0 to 100) their current "general" stress level, as well as their current anxiety in relation to COVID-19. Separate mixed effects models were conducted with days (Level 1) nested within participants (Level 2). Stress variables were lagged by a day to estimate the association between sleep (AM assessment) and stress (PM assessment). TST and SQ were entered as fixed effects and intercepts were allowed to vary randomly.
Results: 4,048 participants (Mage = 46.3 years; 78% women) were included as part of the analyses. The results supported that lower self-reported sleep quality predicted greater general stress levels (b = -1.43, p < 0.001). Lower self-reported sleep quality also predicted greater

COVID-19 related anxiety (b = -0.543, p < 0.001). In contrast, sleep duration was not significantly related to general stress or COVID-19 anxiety after controlling for sleep quality.
Conclusion: The present data supports that daily variations in sleep quality are related to a person's overall stress levels and COVID-19 anxiety. These findings may have implications for the role of good sleep in mitigating the increases in stress that have resulted from the COVID-19 pandemic.
Support (if any): Vargas: K23HL141581

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POTENTIAL LONGITUDINAL ASSOCIATION BETWEEN COVID-19 INFECTION OUTCOMES AND INSOMNIA SYMPTOMS.

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Introduction: The COVID-19 pandemic has had an unequivocal negative impact worldwide, including increases in stress related to social isolation, unemployment, grief, and fear of contracting the virus. This increased stress has likely led to a greater prevalence of sleep continuity disturbance (i.e., insomnia) in the general population. The goal of the present study was to assess the prevalence of sleep continuity disturbance (i.e., insomnia) in the United States during the initial months of the pandemic. In addition, longitudinal assessment is currently ongoing in order to further assess participant experiences with COVID-19. Specifically, these follow-up data will be used to assess whether, among those that contracted COVID-19, insomnia at baseline (Time 1) predicts worse outcomes (e.g., symptoms of greater frequency, duration, or severity) upon follow-up (Time 2).
Methods: A national survey was conducted from April-June 2020. Participants answered questions regarding social distancing practices, mood, sleep, physical activity, and COVID-19 symptoms. Insomnia symptom prevalence and severity were estimated with a retrospective sleep diary and the Insomnia Severity Index (ISI). A follow-up assessment is currently ongoing and will be completed in March 2021. The follow-up survey consists of similar questions and additional items regarding COVID-19 testing, symptoms [frequency, duration, and severity], and outcomes [outpatient treatment, incidence and duration of hospitalization, and incidence and type of respiratory assistance].
Results: 4,133 adults (Mage = 45.8 years; range = 18 - 86 years; 78.7% female) completed the baseline survey. The prevalence of clinically significant sleep continuity disturbance (≥ 30 minutes) was 44.6% for sleep latency problems and 36.2% for wake after sleep onset problems. Nearly 34% of subjects reported average total sleep times of less than 7 hours. Over 17% of subjects (n = 719) reported total ISI scores in the clinical range (ISI total score ≥ 15).
Conclusion: The present study suggests the prevalence of clinically significant insomnia symptoms during COVID-19 remain high in the general population (17–45% depending on definition of insomnia). Similarly, the prevalence of short sleep is elevated. Whether these incident data are associated with COVID-19 outcomes remains to be determined and will be the subject of follow-up analyses in January/February 2021.
Support (if any): Vargas: K23HL141581; Perlis: K24AG055602

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THE ROLE OF INSOMNIA SYMPTOMS IN THE RELATION BETWEEN PERCEIVED VULNERABILITY TO DISEASE AND COVID-19 ANXIETY.

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Introduction: Individuals who report greater perceived vulnerability to disease (e.g., experience emotional discomfort to situations where pathogen transmission is likely) also have the tendency to endorse more anxiety. Insomnia is also associated with greater anxiety. This study assessed (1) whether perceived vulnerability to disease was associated with increased anxiety related to COVID-19 and (2) whether this association was moderated or mediated by insomnia symptoms.
Methods: 1199 primarily female (n = 845), white (n = 982) participants (mage = 30.52) completed an online survey including the Sleep Disorder Symptom Checklist- 25 (SDS-CL-25), Perceived Vulnerability to Disease (PVD) scale, and a rating of COVID-19 anxiety (scale = 0–100; m = 55.81, sd = 25.39). Insomnia symptoms were calculated using the sum of SDS-CL-25 items 3–6 (m = 7.55, sd = 3.58). The PVD subscales germ aversion (GA; m = 4.18, sd = 1.22) and perceived vulnerability to infection (PVI; m = 3.69, sd = 1.39) were also computed.
Results: Regressions were used to test if insomnia mediated the impact of GA and PVI on COVID-19 anxiety. The relations between COVID-19 anxiety and insomnia (b = 1.30, t(1197) = 6.47), GA (b =3.60, t(1197) = 6.09), and PVI (b =3.73, t(1197) = 7.20) were significant (p's < .001). Mediation analyses using the mediation package in R (bootstrap estimation = 1000 samples) showed direct effects of GA (b = 3.26, 95% CI = 2.04 – 4.42, p < .001) and PVI (b = 3.16, 95% CI = 2.00 – 4.22, p < .001) and mediation effects of insomnia (b =.44, 95% CI = .19 - .73, p < .001; b =.58, 95% CI = .33 - .86, p < .001, respectively). According to the moderation analyses, the association between PVD and COVID-19 anxiety did not significantly vary at different levels of insomnia.
Conclusion: Results suggest insomnia symptoms partially mediate the relationship between perceived vulnerability to disease and COVID-19 anxiety. These associations are likely bidirectional, and therefore, more work in this area is needed, especially with regard to how improved sleep may attenuate risk factors for anxiety.
Support (if any): K23HL141581 (PI: Vargas)

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SELF-ISOLATION DUE TO COVID-19 WAS NOT ASSOCIATED WITH CHANGES IN DEPRESSION, SLEEPINESS, AND INSOMNIA IN SHIGA PREFECTURE, JAPAN

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Introduction: We aimed to analyze the changes in depression, sleepiness, insomnia, and sleep habits in relation to the degree of self-isolation due to COVID-19 pandemic. A state of emergency was declared for the whole of Japan on 7 April 2020. People in Shiga prefecture were recommended to stay at home and refrain from moving to other prefectures from 8 April to 31 May 2020.
Methods: We enrolled 54 patients who regularly visited the sleep outpatient clinic in Shiga University of Medical Science Hospital, Japan. We compared the sleep habits, depression (Patient Health Questionnaire-9: PHQ-9), insomnia (Athens Insomnia Scale: AIS), and sleepiness (Epworth Sleepiness Scale: ESS) of patients, one year before (from April to July 2019), during (May 2020) and six months after (Nov 2020) the self-isolation period due to the COVID-19. We conducted repeated measures ANOVA to examine changes.

Results: PHQ-9 (3.89±0.64, 3.65±0.62 and 3.52±0.66: p=0.410), AIS (4.78±0.59, 4.65±0.57 and 4.63±0.57: p=0.843) and ESS (7.93±0.76, 7.07±0.68 and 7.00±0.73: p=0.088) were not significantly different among three visits. Sleep duration (6.06±0.23hr, 6.29±0.19hr and 6.16±0.22hr: p=0.248) and sleep onset latency (24.8±5.55min, 19.2±3.97min and 21.0±4.85min: p=0.445) were also not significantly different.
Conclusion: Self-isolation due to COVID-19 was not associated with changes in depression, sleepiness, and insomnia among patients for sleep outpatient units in in Shiga prefecture, Japan.
Support (if any): The present study was supported by MEXT/JSPS (KAKENHI Grant Number: 17H00872).

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PATIENT PERSPECTIVES ON TELESLEEP CARE IN COVID TIMES: AN URBAN TEACHING HOSPITAL SURVEY.

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Introduction: Telehealth is a relatively new tool for patient care, and to reach underserved areas where certain specialties are available. With the advent of the COVID19 pandemic, Telehealth has become a universal way to provide safe and quality patient care. However, Telehealth is a new experience for many providers and patients. We surveyed patients who received telehealth visits in sleep medicine between March and June 2020 to determine patient satisfaction and common technology-related barriers. The goal was to formulate actionable steps for improving patient's experiences and determine the feasibility of long-term telehealth services for sleep medicine.
Methods: We interviewed 63 patients by phone, utilizing IRB approved surveys for telehealth satisfaction and technology. Responses were de-identified, tabulated, and analyzed in aggregate using Excel®.
Results: 85% of respondents had a high-school diploma or a higher level of education (9.6% students, 39.7% employed, 15.9% unemployed, and 19% retirees). 62% of participants participated in Telehealth for the first time. 89% preferred Telehealth, and 76% rated telehealth experience as good or better than in-person visits. 92% did not require technical assistance during the visit. Long-term telehealth care was acceptable to 63% of participants. Approximately 33% had technology-related barriers (no computer or webcam), and 12% did not have email. However, 89% had smartphones (70% connected to personal internet). Other barriers cited were lack of private space (13%) and taking time off work (9%). No clear preference for phone versus video Telehealth was noted (approximately 40% each), but 7% expressed concern about bi-directional video communication. This may be related to the privacy and security concerns expressed by 20% of respondents. However, only 5% reported using the electronic health record (EHR) based secure communication portal.
Conclusion: Sleep care via Telehealth is preferred by most patients during the COVID pandemic and is acceptable to two-thirds of patients for the long-term. In addition to access to personal devices or the internet, privacy concerns were a barrier to Telehealth. We plan to increase patient enrollment in the EHR-based portal to deliver telehealth services and communication securely to mitigate these barriers.
Support (if any):

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ADJUSTING FIRE - PILOTING AN ONLINE SLEEP CLASS IN A U.S. AIR FORCE POPULATION IN RESPONSE TO COVID-19 PATIENT CARE RESTRICTIONS

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Introduction: Sleep problems remain problematically prevalent among U.S. service members. In 2015 over 60% of sampled service members reported getting less than 7 hours of sleep per night, 31.4% getting 5 hours or less, and nearly 50% reported subthreshold insomnia symptoms on the Pittsburgh Sleep Quality Index. Ongoing COVID-19 service delivery restrictions necessitate a rapid shift to virtual health solutions and illuminate barriers to the delivery of sleep interventions. This process improvement pilot was a proof-of-concept during uncertain times.
Methods: From September to January 2020, 10 weekly 1-time, 60-min virtual sleep classes were held over Microsoft Teams. Interventions were consistent with Motivational Interviewing and Brief Behavioral Treatment for Insomnia. Participants completed the STOP BANG and Insomnia Severity Index (ISI) before each class, and accomplished the ISI again at a 2-week contact during which they rated progress toward problem resolution and were offered additional clinical services as-needed.
Results: Forty-six participants attended the class. 67% responded to the post-class survey. 74% responded to the two-week follow-up. A majority (84%) indicated either agreement or strong agreement with the statement 'I plan to CHANGE a behavior or TRY an intervention I learned to better my sleep', and many proceeded to establish a more consistent sleep schedule (n=14; 45%), remove electronics from the bedroom (n=13; 42%), and/or go to bed only when sleepy (n=11; 35%). 84% would recommend this class to others with similar concerns. Scaled from 1 ('no change') to 10 ('full resolution'), participants reported having derived modest benefit from the intervention (M = 4.1, SD=1.7). Eleven (35%) denied need for additional sleep-related services, and 84% expressed intent to recommend the class to others with similar concerns.
Conclusion: Results suggest a military population is receptive to a 1-time, virtual sleep class consistent with social distancing strictures. This service provided patients rapid access to care while contemporaneously reducing demand for time-intensive one-to-one appointments. As hypothesized, receipt of the intervention was associated with intention to modify sleep-relevant behavior, and with meaningful progress toward resolution of sleep difficulty as assessed at 2-week follow-up. Broadly disseminated, this intervention could introduce an internet-based, stepped-care approach to management of sleep insufficiency across the DoD.
Support (if any):

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OPTIMIZING TELEHEALTH TECHNOLOGY IN SLEEP MEDICINE AT A VA MEDICAL CENTER DURING THE COVID19 PANDEMIC.

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Introduction: The COVID19 pandemic poses an unprecedented challenge for healthcare delivery. Optimization of resources and safety of patients and healthcare workers is crucial. The aim of this study is to analyze impact on resource utilization at VA Maryland Healthcare System (VAMHCS). At the pandemic onset, we deployed a mail-in

store-and-forward technology (SFT) for carrying out home sleep apnea testing (HSAT), using WatchpatDirect® Peripheral Arterial Tonometry-based testing. This led to a substantial decrease in reliance on care in the community (CITC) or out-of-VA care, resulting in fiscal savings. Interpretation of studies is done by VA physicians using a cloud-based network, resulting in improved workforce optimization and continuity of care.

Methods: We compared CITC expenditures for sleep studies in financial year (FY) 2019 (October 2018 to September 2019) with that of FY2020 in the VA Support Service Center Capital Assets (VSSC) database.

Results: In FY2019, VAMHCS conducted 402 polysomnograms, 805 HSATs and referred 64 patients to CITC, including 5 HSATs, with CITC costs of $102,388. CITC referral initiated by primary care providers often resulted in clinic visit and polysomnography (PSG). In FY2020, VAMHCS conducted 436 PSGs, 986 HSATs and referred 10 patients to CITC, including 3 HSATs, costing $6,780; a decrease of $95,608 compared to FY2019. The ratio of VA to CITC studies was 18:1 in FY2019, compared to 142:1 in FY2020. VAMHCS conducted 166 HSATs between 3-15-2020 and 6-30-2020, while the sleep lab was closed due to COVID surge, at a cost of $160 per study. According to VSSC data, an average of $1,005 is spent per patient (including a third-party administrator fee of $200) when utilizing CITC. Approximately 80% of CITC referrals underwent PSG. If all studies were done using CITC, it would have cost an additional $ 140,270. The cost would have been $546, 855 if all studies done between 3-15-2020 and 9-30-2020 were done through CITC.

Conclusion: The use of SFT during the pandemic resulted in VAMHCS relying less on CITC, leading to a decrease in expenditure, administrative burden and turnaround time. SFT minimizes the risk of infection transmission because PAT probes are disposable and obviates patient visits to the hospital.

Support (if any):

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CHRONOTYPE ASSOCIATIONS WITH INSOMNIA, DEPRESSIVE SYMPTOMS, AND CHANGES IN SLEEP AND HEALTH BEHAVIORS DURING THE COVID-19 PANDEMIC

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Introduction: Evening chronotype (i.e., night owl preference) is associated with worse insomnia and depressive symptoms, and poorer health behaviors. The aim of this study was to examine the association between chronotype and these symptoms and health behaviors during COVID-19 pandemic quarantine.

Methods: An online survey, distributed internationally via social media from 5/21/2020–7/1/2020, asked adults to report sociodemographic/economic information, changes in sleep (midpoint, total sleep time, sleep efficiency, time-in-bed), and health behaviors (i.e., physical activity, sedentary screen time, and outdoor light exposure patterns) from prior to during the pandemic, chronotype preference (definitely morning [DM], rather more morning [RM], rather more evening [RE], or definitely evening [DE]), and complete the Insomnia Severity Index (ISI) and the 10-item Center for Epidemiologic Studies Depression scale (CES-D-10). Multinomial logistic regression and ANCOVA models, adjusting for age and sex, examined associations of chronotype with COVID-19 pandemic related impacts on sleep, depressive symptoms, and health behaviors.

Results: A subsample of 579 participants (M age: 39y, range: 18–80; 73.6% female), currently under quarantine and neither pregnant nor performing shift work, represented each chronotype evenly (~25%). Participants delayed their sleep midpoint by 72.0min (SD=111.5) during the pandemic. DE chronotypes had a greater delay than morning types (M±SD DE: 91.0±9.0 vs. RM: 55.9±9.2 & DM: 66.1±9.3; p=0.046) with no significant change in other sleep patterns relative to other chronotypes. However, DE and RE chronotypes had greater odds of reporting that their new sleep/wake schedule was still not consistent with their "body clock" preference relative to morning types (X2[15]=54.8, p<0.001), reported greater ISI (F[3,503]=5.3, p=.001) and CES-D-10 scores (F[3,492]=7.9, p<.001), and had greater odds for increased or consistently moderate-to-high sedentary screen time (X2[12]=22.7, p=0.03) and decreased physical activity (X2[12]=22.5, p=0.03) than DM chronotype. There was no significant difference in change in outdoor light exposure by chronotype (X2[12]=12.1, p=0.43).

Conclusion: In an international online sample of adults under COVID-19 pandemic quarantine, evening chronotypes, despite taking the opportunity to delay sleep to match biological clock preference, reported their sleep/wake schedules were still inconsistent with personal preference, and reported greater insomnia and depressive symptoms, and odds of engaging in poorer health behaviors than morning chronotypes.

Support (if any):

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CHRONOTYPE, MOOD, AND DIABETES-RELATED DISTRESS IN ADULTS WITH TYPE 2 DIABETES

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Introduction: Chronotype refers to an individual's preferred timing of sleep and wakefulness, which can be classified as 'normal' or 'late' chronotypes. The purpose of this study was to examine whether late sleep timing was associated with impaired mood and diabetes-related distress in persons with type 2 diabetes (T2D).

Methods: The study is a secondary analysis of pooled cross-sectional baseline data from two studies of treatment of obstructive sleep apnea (R01-DK96028) and insomnia (K24-NR016685) in persons with T2D. Sleep timing was measured by the bedtime from a 7-day sleep diary. "Normal" sleep timing was defined as bedtime between 9PM to 12AM ≥ 85% per week. "Late" sleep timing as bedtime after 12AM with normal sleep timing < 85% per week. Other sleep variables evaluated were sleep duration, daytime sleepiness (Epworth Sleepiness Scale [ESS]), and OSA severity (apnea-hypopnea index [AHI]). The Profiles of Mood States measured Total Mood Disturbance (TMD) and the subscales of Tension-Anxiety (T-A), Depression-Dejection (D-D), Anger-Hostility (A-H), Vigor-Activity (V-A), Fatigue-Inertia (F-I), and Confusion-Bewilderment (C-B). Diabetes-related distress was measured by the Problem Areas in Diabetes (PAID). Hierarchical multiple regression was performed to determine whether sleep timing was associated with mood and diabetes-related distress.

Results: The sample (N=296) had 61% with late sleep timing (n=181). Persons with normal vs late sleep timing were similar in age, sex, race, and education (p >.05). Persons with late sleep timing were less likely to be partnered, had shorter sleep duration and greater mood impairment (TMD and T-A, D-D, A-H, C-B subscales) than those with normal timing (all p values <.05); there was no significant difference by sleep timing in PAID scores (p=.256). Hierarchical regression analyses adjusting for demographics (age, sex, race, marital status, education level), clinical (HbA1c, BMI), and sleep variables (sleep duration, ESS, AHI) revealed that late sleep timing was not

significantly associated with impaired mood (TMD and subscales) or PAID. However, ESS was statistically significant in predicting greater TMD (β=.310, p <.001), mood subscales (all p-values <.05) and PAID (β =.222, p <.001).
Conclusion: Daytime sleepiness, not late sleep timing, is a significant sleep-related symptom for increased mood impairment and diabetes-related distress in persons with T2D.
Support (if any):

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PAP THERAPY: A REVIEW OF RESOURCES FOR THE UNINSURED DURING COVID-19

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Introduction: In 2019, the United States Census estimated 8% (26.1 million) people were without health insurance. Further, an estimated 3.5 million people became/remained uninsured from COVID-19-related job losses. Patients with OSA that belong to a lower socioeconomic status (SES) are less likely to have access to healthcare and may be under or uninsured. Untreated OSA can lead to increased risk of symptoms and associated co-morbidities. Resources to help the uninsured to obtain PAP therapy were available pre-COVID, including two main sources, American Sleep Apnea Association (ASAA) and our local branch serving central Ohio, The Breathing Association. However, the COVID pandemic limited access or closed these programs. Our Sleep Medicine clinics saw 148 uninsured OSA patients between March-December, 2020. Given these difficulties, we re-evaluated available resources for the uninsured.
Methods: We conducted a search for current low cost ($100 or less) PAP therapy options for the uninsured, March 15, 2020-December 3, 2020, by: (1) contacting pre-COVID-19 resources, including Durable Medical Equipment (DME) providers, (2) consulting social work, and (3) completing a librarian assisted web-search not limited to PubMed, Embase, CINAHL for academic related articles and electronic searches using a combination of English complete word and common keywords: OSA, PAP, uninsured, no insurance, cheap, medically uninsured, resources, self-pay, low-income, financial assistance, US. Resources such as private sellers were not investigated.
Results: During COVID-19, assistance for PAP machines/supplies have closed or required a protracted wait-time. Options including refurbished items range from low, one-time fixed cost or income-based discounts from: one local charity (Joint Organization for Inner-City Needs) and DME (Dasco), and four national entities (ASAA, Second Wind CPAP, Reggie White Foundation, CPAP Liquidators). An Electronic Health Record-based tool was developed and distributed to increase provider awareness of pandemic available resources.
Conclusion: Untreated OSA is associated with increased risk of cardiovascular co-morbidities. Access and cost may limit treatment in OSA patients from a lower SES. The COVID-19 pandemic has shuttered programs providing discount PAP and supplies, leaving fewer resources for these patients, thus further widening this health care disparity. Alternatives are needed and current resources are not easily accessible for providers and patients.
Support (if any):

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IMPROVED SLEEP AFTER A BRIEF INTERVENTION FOR INSOMNIA MEDIATES IMPROVEMENTS IN DEPRESSION SYMPTOMS DURING THE COVID-19 PANDEMIC

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Introduction: The COVID-19 Pandemic and mitigation efforts have led to drastic increases in acute insomnia symptoms, which left untreated may contribute to increased risk for other negative mental health outcomes, including depression. However, the impact of treating acute insomnia symptoms on future depression outcomes remains unknown. Moreover, whether sleep improvements as a result of an insomnia treatment mediate subsequent reduction of depression symptoms similarly remains unknown.
Methods: At this writing, 44 individuals experiencing insomnia symptoms (Insomnia Severity Index; ISI ≥ 10) that began during the COVID-19 pandemic have been randomized to receive a brief, telehealth Cognitive Behavioral Therapy for Insomnia (CBTI) waitlist control. Treatment was delivered in 4 sessions over a 5-week period. CBTI is the gold-standard behavioral intervention for chronic insomnia and has been applied successfully via telemedicine. Outcome measures were depressive symptoms as measured by the Patient Health Questionnare-9 (PHQ-9) minus the sleep item and insomnia symptom severity as measured by the ISI. Both outcome measures were collected at baseline (week 0), throughout treatment phase (weeks 2–6), and at the post-treatment (week 7). Linear mixed models determined the impact of treatment on depression and insomnia symptom severity. Mediation was tested using the MacArthur framework.
Results: There was a significant Group x Time interaction, with CBTI leading to a greater rate of improvement in ISI (b = -1.14, p < 0.001) and PHQ-9 (b = -0.61, p = 0.002) than the control. Critically, the rate of improvement in insomnia symptoms to the last session of treatment, was associated with the subsequent improvement in depressive symptoms post-treatment (b = 2.06, p = 0.017). In contrast, depressive symptom improvement was not associated with insomnia symptom improvement (b = 4.28, p = 0.102).
Conclusion: This preliminary data suggests that brief CBTI can reduce pandemic onset insomnia and other depressive symptoms. The preliminary mediation results further suggest that sleep may be an important treatment target for reducing situational depressive symptoms and supports the need to examine the physiological mechanisms of sleep using high-density EEG in a larger sample.
Support (if any):

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CHARACTERISTICS OF RESPONDENTS TO A VIRTUAL TRIAL OF A DIGITAL BEHAVIORAL TREATMENT FOR INSOMNIA DURING THE COVID-19 PANDEMIC

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Introduction: Rates of sleep disturbance and sleep medication use have increased during the COVID-19 pandemic, at a time when face-to-face delivery of behavioral insomnia treatments is severely limited. To support research during the pandemic, the FDA released guidelines promoting the use of "alternative methods" to conduct trials in a virtual or decentralized manner. Currently, few data exist regarding the impact of virtual trial enrollment during a pandemic. This

abstract presents data from a decentralized, open-label, single-arm real-world clinical trial of the Somryst prescription digital therapeutic for insomnia, which provides insight on who seeks care for insomnia using virtual research methods.

Methods: In alignment with FDA guidance, the DREAM trial began enrolling patients in March, 2020 with an expected final sample size of 350 adults (Clinical Trial # NCT04325464). This abstract presents data from participants seeking enrollment into the trial via an online screening. Demographic and sleep variables were collected to confirm eligibility.

Results: Of 1,063 respondents, the majority were female (62%) and the most common age brackets were ages 30–39 (22%); 40–49 (20%); and 50–59 (20%). Most respondents (63.8%) did not report being under the care of a healthcare provider for their insomnia. Respondents reported sleep problems for an average of 12.9 years; sleep problems 5 nights/week; and sleeping an average of 5.4 hours/night. Geographic diversity was high with respondents from 45 states and Washington DC. Of those passing initial screening (N=270), 5.5% reported having another diagnosed sleep disorder, 14.4% reported a comorbid psychological condition, 58.9% reported taking a medication for insomnia, and 30.7% reported taking a medication for depression. Using the Insomnia Severity Index, 16.7% had subthreshold/mild insomnia (score 8–14), 60.0% had moderate insomnia (score 15–21), and 23.7% had severe insomnia (score > 21).

Conclusion: Respondents to this decentralized trial reported moderate-severe, long-lasting insomnia with high rates of medication use for sleep and depression. Results demonstrate that virtual trials can quickly draw a highly geographically diverse research population, overcoming logistical challenges inherent in a pandemic and resulting in recruiting appropriate, but more geographically diverse, samples than those typically observed in randomized trials of cognitive behavioral therapy for insomnia (CBT-I).

Support (if any):

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INSUFFICIENT SLEEP AND MORTALITY AMONG PERSONS WHO INJECT DRUGS (PWID)

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Introduction: Insufficient sleep is associated with all-cause mortality in the general population. Illicit drugs have pronounced effects upon sleep, and insomnia symptoms are common among people with HIV (PWH), suggesting persons who inject drugs (PWID) with HIV may be at higher risk of adverse outcomes from insufficient sleep.

Methods: Participants in the AIDS Linked to the IntraVenous Experience (ALIVE) study, a cohort of PWID with or without HIV, completed the Sleep Adequacy subscale of the Medical Outcomes Study (MOS) semi-annually from 2005-present. Two questions queried participants about the frequency over the past four-weeks of: 1. getting sufficient sleep to feel rested on awakening; 2. obtaining needed amount of sleep. Six-Item responses ranged from “all of the time” to “none of the time”. Participants with mean subscale scores below the sample median were considered to have insufficient sleep. Mortality data were obtained through the National Death Index through 2018. Hazards of all-cause and cause-specific mortality were evaluated using Cox-regressions accounting for repeated measurements of insufficient sleep, respectively. Models were adjusted for sociodemographics, HIV and HCV infection, severe depressive symptoms (Center for Epidemiological Studies Depression [CESD]≥23), number of comorbidities (0, 1, ≥2), active injection drug use, current tobacco and alcohol use.

Results: Of 2612 participants (33% HIV+), mean age at baseline was 45.8 years, 32.4% were female, 75% Black, 45% had ≥high school education, and 33% had an annual income >$5,000. At baseline, the majority were current smokers (84%), alcohol drinkers (59%), or actively injecting drugs (56%), while 25% had severe depressive symptoms and 21% had ≥2 comorbidities. After adjustment for covariates, insufficient sleep was associated with a 37% increased hazard of all-cause mortality (HR: 1.37, 95% confidence interval [CI]: 1.13–1.65). Insufficient sleep was associated with a 93% increased hazard of death from HIV or infectious disease-related deaths (HR: 1.93, 95% CI: 1.26–2.97).

Conclusion: Insufficient sleep was independently associated with all-cause mortality and specifically with death from HIV or infectious diseases-related causes among PWID. Interventions consider targeting sleep behaviors among PWID hold promise for improving health and longevity in this population.

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SLEEP ARCHITECTURE IN THE INTENSIVE CARE UNIT AS REVEALED VIA BREATHING AND HEART RATE VARIABILITY

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Introduction: Sleep in the intensive care unit (ICU) is difficult to measure by conventional polysomnography. We investigated the feasibility of assessing sleep state from readily available ICU signals: heart rate variability (HRV) from electrocardiography and breathing from a wearable respiratory band. We compared findings with an age and sex matched sleep laboratory group.

Methods: As part of a clinical trial, 102 adult non-ventilated patients in three ICUs in the Massachusetts General Hospital wore a respiratory band. Both heart rate variability (RR-intervals) from ECG, and breathing (respiratory effort waveforms) data for up to seven days per patient were obtained. 220 age- and sex-matched subjects from a sleep lab cohort who wore the same respiratory effort band and ECG were selected for comparison. We staged sleep from the HRV and breathing data using previously published deep neural network models. We defined discordant sleep epochs as those where HRV- and breathing-based models disagreed. Agreement was computed for the following pairs: (R,R),(N1,N1),(N2,N2),(N3,N3),(N1,W),(N1,N2),(N2,N3).

Results: Demographics: Mean(STD) age: ICU 68(9), sleeplab 68(9); BMI: ICU 27(6), sleeplab 31(6); ICU 40% female, sleeplab 44% female; race: ICU%:Sleeplab% 90:69 White, 5:4 Black, 2:7 Asian. 34% of ICU-subjects were in a medical ICU, 66% in a surgical ICU. Mean total sleep duration in the ICU was 8.9 hours (4.5h concordant, 4.4h discordant sleep). We observed increased amounts of discordant sleep in the ICU compared with the sleeplab cohort (4.4h vs. 1h, $p<0.01$). We found different REM sleep distributions ($p<0.01$) with reduced median (10% vs. 20%) but elevated 90% quantile (45% vs. 26%), elevated N1(%) (41% vs. 26%, $p<0.05$), reduced N2(%) (19 vs. 44, $p<0.01$), and reduced N2+N3(%) (34 vs. 59, $p<0.05$). We further observed higher mean respiratory rate (17.4 vs. 15.9 breaths per minute,

p<0.01), lower inter-breath-intervals (3.9 vs. 4.7 seconds per breath, p<0.01), and more breathing variability than in sleeplab AHI<5 group but less than in AHI>15 group.
Conclusion: HRV and respiratory-based measures can assess sleep in the ICU. The findings of increased discordant sleep in the ICU might stem from limitations of the models, fundamental changes in sleep biology during critical illness, pharmaceutical drugs, sleep fragmentation, and/or associated pathology in the ICU.
Support (if any):

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EFFECTS OF SLEEP-EXTEND ON GLUCOSE METABOLISM IN WOMEN WITH A HISTORY OF GESTATIONAL DIABETES: A PILOT STUDY

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Introduction: Experimental and epidemiological data have linked insufficient sleep to increased diabetes risk. Women with a history of gestational diabetes (GDM) have a 7-fold greater risk of developing type 2 diabetes. This pilot study explored the feasibility of a sleep extension intervention in women with a history of GDM and short sleep, and the effects on glucose metabolism.
Methods: Women age 18–45 years with a history of GDM (at least 1 year postpartum) and actigraphy confirmed short sleep duration (<7h/night) on weekdays were randomized at a ratio of 1 control (healthy living information) to 2 cases (6 weeks of "Sleep Extend" intervention: use of a Fitbit, weekly digital content, interactive tools, and coach delivered feedback in order to increase sleep duration). An oral glucose tolerance test (OGTT), 7-day actigraphy recording and questionnaires were obtained at baseline and 6 weeks (at the end of the intervention).
Results: Twelve women (mean (SD) age 40.3 (4.5) years) participated (n=8 Sleep Extend, n=4 control). Compared to baseline, nightly sleep duration increased in Sleep Extend group (+30.6 (48.8) minutes) but decreased in the control group (-6.8 (22.9) minutes). Both fasting and 2-h glucose levels from OGTT increased in both groups but were greater in the control group (Sleep extend vs. healthy living: fasting glucose +2.1 (9.8) vs. +12.8 (7.3) mg/dL; 2-h glucose +8.2 (21.9) vs. +20.0 (19.4) mg/dL). Self-reported sleep quality improved in both groups. When compared controls, Sleep Extend participants reported improved fatigue symptoms (Promis fatigue score change -5.1 (9.3) vs. 7.0 (1.0), p=0.008), and self-reported physical activity tended to increase (+1614 (3659) vs. -2900 (3922) MET-minutes/week). Combining all participants, an increase in sleep duration correlated with a decrease in fatigue (r= -.62, p=0.04) and anxiety symptoms (r= -.69, p=0.02).
Conclusion: Sleep extension through coaching and use of remote monitoring is feasible in women with a history of GDM. It appears to decrease fatigue and may improve glucose metabolism and physical activity.
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UTILIZING RISK SCORE ASSESSMENT TO MAXIMIZE SLEEP RESEARCH PARTICIPANT SAFETY DURING THE COVID-19 PANDEMIC

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Introduction: Research study recruitment has been profoundly affected by the COVID-19 pandemic, demonstrated by significant delays or pauses. Various guidelines pertaining to in-person visits have applied to research. Some call for exclusion of participants that the CDC has labeled "at increased risk".1 For obstructive sleep apnea (OSA) studies, these guidelines have caused a sharp decrease in the number of new participants. This decrease is due to high rates of OSA comorbidities including obesity and diabetes. New evidence-based risk scores have been developed using individual- and community-level factors. The use of more refined COVID-19 risk scores can help protect patient safety while allowing research to continue.
Methods: The risk score assessment used for this study (COVID-19 Mortality Risk Calculator; Johns Hopkins University, Baltimore, MD)2 is evidence-based and uses a set of risk factors and community-level pandemic dynamics in the state of residence.3,4 It was compared to the list of CDC medical conditions that are considered to put an individual "at increased risk." Both measures were calculated retrospectively on current participants to determine how many could safely attend in-person visits based on each risk assessment method.
Results: Sample characteristics of the 110 participants were: mean age: 49.5±13.7(24–76); mean BMI: 32.3±5.3(20.9–46.1); mean AHI: 24.3±21.4(5.1–110). Mortality Risk Calculator scores were: 91(82.7%) close to/lower than average [Level 1]; 12(10.9%) moderately elevated; 6(5.5%) substantially elevated; 1(0.9%) high; and 0(0%) very high [Level 5]. Using CDC guidance, 63 (57.3%) had at least one at-risk condition and 47 (42.7%) had 0. Using only Level 1 of the Risk Calculator would allow an additional 28 (25%) participants to attend in-person visits; using Levels 1 and 2 would allow an additional 40 (37%) participants.
Conclusion: Policies based on CDC at-risk conditions resulted in higher levels of participant exclusion in research during the COVID-19 pandemic than use of an evidence-based Mortality Risk Calculator. This analysis shows that researchers can use risk-adjusted scores to make informed decisions about study participation that balances both participant safety and research study progress.
Support (if any): This project was supported in part by Department of Veteran Affairs VA HSRD IIR 16–277, VA RRD D2651-R, and VA San Diego Healthcare System Research Service.

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INCREASED NIGHTMARES DURING THE COVID-19 PANDEMIC: EXPLORING THE ROLE OF RESILIENCE AND EMOTIONS

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Introduction: COVID-19 had a tremendous impact on many aspects of our lives and has caused an increase in stress and mental health issues in many people. We have recently found that there was an increase in nightmares during the pandemic in young adults. Since emotions have been associated with both resilience and nightmares, the objective of this study was to investigate the role of resilience and emotional changes in the increase in nightmares observed during the pandemic, in a group of young adults.
Methods: Resilience, emotions and nightmares were assessed using the Connor-Davidson Resilience Scale-10, the Differential Emotions Scale-IV and an adapted version of the Pittsburgh Sleep Quality Index. Measures were administered to 209 young adults (18–25 years old, 76.1% females). Hierarchical multiple regression models were computed to examine the unique contribution of changes in positive and negative emotions during the pandemic to the increase in nightmares during the pandemic. Analyses were controlled for nightmares and emotions prior to COVID-19, and for gender. The sample was separated in two groups: resilient and less resilient young adults.

Results: Results show that in less resilient young adults, nightmares prior to COVID-19 (β=.79, p<.001) and increase in negative emotions (β=.21, p=.033) significantly predicted nightmares during the pandemic and explained 67.0% of their variance. In resilient young adults, nightmares prior to COVID-19 (β=.56, p<.001) and gender (β=-.15, p=.04) significantly predicted nightmares during the pandemic and explained 52.0% of the variance.
Conclusion: Our results show that increase in negative emotions during the pandemic is associated with an increase in nightmares in less resilient young adults, but not in resilient young adults. Furthermore, our results show that in resilient young adults, being a woman is associated with an increase in nightmares during the pandemic. These results suggest that resilience may be a protective factor in managing the impact of negative emotions on nightmares, but only in men.
Support (if any):

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CHANGES IN CHILDHOOD SLEEP PATTERNS IN AN INTERVENTION STUDY PRIOR TO AND DURING COVID19 RESTRICTIONS

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Introduction: We conducted a childhood sleep promotion study between March 2019 and December 2020 in Philadelphia. COVID19 was first detected in Pennsylvania in March 2020 and non-essential services were strictly curtailed (including school closures), with easing of curtailments by the fall 2020 (including hybrid schooling in some districts). We determined if changes in sleep duration were consistent during pre-, earlier, and later COVID19 periods.
Methods: Typically developing children (9-12y) with sleep duration <8.5 hours per weeknight were enrolled. Sleep was measured using Fitbit devices during a baseline week and a 7-week intervention period. A factorial design was used to test five candidate intervention components: 1) sleep goal; 2) electronic device reduction messaging; 3) daily routine messaging; 4) child-directed financial incentive; and 5) parent-directed financial incentive. Sleep data were transmitted to a mobile health platform that automated delivery of the intervention components. We categorized participants when they completed the study: 1) Spring-Fall 2019 semesters (pre-COVID19); 2) Spring 2020 semester (started pre-COVID19, with strict restrictions impacting intervention periods); or 3) Fall 2020 semester (easing of COVID19 restrictions). Mixed effect modelling determined sleep changes.
Results: Mean age of participants was 11.6y (51% female and 29% Black participants). Pre-COVID19 (N=59), average sleep duration increased from baseline by 21 (95% CI: 10, 30) minutes per weeknight during the intervention. In spring 2020 (N=18), the average sleep duration increase was two times larger in magnitude at 41 (95% CI: 25, 59) minutes per weeknight. For fall 2020 (N=20), the average sleep duration increase was 24 (95% CI: 7, 40) minutes per weeknight. Changes in sleep timing from baseline during the intervention were consistent pre-COVID19 and in the fall 2020 (e.g., ≈15 minutes earlier sleep onset throughout the intervention period), whereas sleep timing changes were dynamic in the spring 2020 (e.g., 41 minutes earlier for week 1, and 44 minutes later for week 7).
Conclusion: This sleep intervention demonstrated increases in sleep duration pre-COVID19, with marked duration increases and dynamic timing changes coinciding with COVID19 restrictions during earlier (Spring 2020), but not later (Fall 2020), weeks of the COVID19 pandemic in Pennsylvania.
Support (if any): K0 1 HL1 2 3 6 1 2 and CHOP

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Social media for students sleep health promotion: A health intervention report during COVID -19

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Introduction: The COVID-19 pandemic affected sleep health. Students' sleep health requires cognitive processes, mental and physical balance. We assume that the pandemic COVID-19 has modified some sleep habits by eliciting environmental and social interaction changes. According to the perspective that the students need health education interventions on sleep hygiene, we aimed to promote sleep health education based on social media in students using Instagram.
Methods: Students participated by answering an online questionnaire in Instagram platform. The sample was 300 students with internet access between two weeks of March/2020. This period refers to the second and third week of the social isolation policy enacted due COVID-19. The Snowball strategy was the dissemination method, a non-probabilistic sampling technique in which the participants invited new participants from their network of acquaintances.
Results: The valid responses were from students among 18–24 y.o. The sample was mostly female (61,7%), between 18 and 22 y.o., and they sleeped less than 8 hours. Also, 76,3% of the surveyed reported somnolence during the day, 70,2% anxiety and 87,8% worse sleep associated to stress and/or anxiety, which indicated the variables for an educational health intervention design in this context. Most of the sample did stipulate a schedule to wake up on the weekdays (96,6%), and 24,4% of the sample didn't stipulate a fixed schedule for bedtime during the weekdays. More than 150 people (53,2%) didn't make any effort to avoid screens before sleeping. The responses' distribution showed that an average number of people (73,9%) try to avoid using the bed for work or watch television, and 83,1% seek to avoid heavy foods before sleeping.
Conclusion: The Instagram profile focused on the main sleep issues seen in the survey. The posts were created using subjects about sleep process, sleep hygiene practices for students; sleep stages, function and regulation; sleep-wake circadian rhythms. The creation of the @ comodormimos profile on Instagram was based on the need for a subject understanding by the researched public. Coronavirus' pandemic increased the harmful sleep behavior of students. Further studies should be done to understand the impact of COVID-19 pandemic in the student's sleep health.
Support (if any):

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COVID-19 ANXIETY AND SLEEP IN MIDDLE-AGED AND OLDER ADULTS: IMPACT OF AGE AND SEX

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Introduction: COVID-19 is an infectious respiratory illness that was declared a pandemic in March 2020. During the course of COVID-19,

studies have demonstrated worsening sleep quality and anxiety. No studies have examined age-related and sex-specific associations between COVID-19 anxiety and sleep in aging populations. We examined associations between COVID-19 anxiety and sleep, and evaluated age and sex as moderators, in middle-aged/older adults.

Methods: Two hundred and seventy-seven middle-aged/older adults aged 50+ (Mage=64.68, SD=7.83; 44% women) living in the United States who were cognitively healthy (no cognitive impairment/dementia/neurological disorders) completed an online Qualtrics survey in July/August 2020 measuring sleep (Pittsburgh Sleep Quality Index; PSQI) and COVID-19 anxiety (Coronavirus Anxiety Scale; CAS). Multiple regressions examined whether CAS was independently associated with or interacted with age or sex in its associations with PSQI total score/subscores (sleep quality, sleep duration, sleep efficiency, daytime dysfunction), controlling for age, education, number of medical conditions, sleep/pain medication use, and COVID-19 status.

Results: CAS interacted with age (B=-.008, SE=.003 p=.02, R-squared=.02), not sex (p=.31), in its association with sleep duration. Higher CAS was associated with shorter sleep duration in oldest-older adults (~73 years old; B=.12, SE=.05, p=.01) and younger-older adults (~65 years old; B=.07, SE=.03, p=.02), not middle-aged adults (~57 years old, p=.47). CAS interacted with age (B=.01, SE=.004, p=.02), not sex (p=.56), in its association with sleep efficiency. Higher CAS was associated with worse sleep efficiency in oldest-older adults (B=.14, SE=.05, p=.009) and younger-older adults (B=.08, SE=.04, p=.03), not middle-aged adults (p=.60). Higher CAS was associated with greater daytime dysfunction (B=.26, SE=.07, p<.001) and higher PSQI total score (B=.82, SE=.33, p=.01), and did not interact with age or sex (ps>.05).

Conclusion: Increased COVID-19 anxiety is associated with several aspects of worse sleep (shorter sleep duration, sleep efficiency) in older adults but not middle-aged adults. Generally, in middle-aged/older adults, higher COVID-19 anxiety is associated with worse daytime dysfunction and overall sleep quality. Sex does not moderate these associations. Increased COVID-19 morbidity and mortality in aging populations may translate to increased anxiety and subsequent sleep disruptions. Interventions aimed at mitigating negative pandemic-related psychological and sleep outcomes may be particularly relevant for older adults.

Support (if any):

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DID THE COVID-19 PANDEMIC INCREASE INSOMNIA?

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Introduction: COVID-19 has been an unprecedented health event with far-reaching health and economic consequences. There have been numerous surveys published that have suggested that insomnia has increased during the pandemic. However, there have been no comparisons of data from the pandemic with that from other years. Here we present baseline data from people signing up to an online CBTi course to investigate the impact of COVID-19 on sleep.

Methods: We investigated the difference in age; diary-reported Sleep Efficiency (SE%) and Total Sleep Time (TST); sleep quality and disturbances as measured by the Pittsburgh Sleep Quality Index (PSQI) and daytime sleepiness using the Epworth Sleepiness Scale (ESS); between the first wave of COVID-19 in the UK (1st March -31st July 2020) as compared to the same period in 2019.

Results: In 2019 n=2231 patients were assessed as compared to n=6173 in 2020. There were no significant differences in the age of the two cohorts (47.1 years v 46.3 years, NS). SE% was significantly lower in the 2019 cohort (66% v 67.6, p <0.001) as was their total sleep time (5.71 hrs v 6.05 hrs, p<0.0001). PSQI scores were also higher in 2019 (13.13 v 12.72. p<0.0001). The level of daytime sleepiness was lower in the 2019 cohort (5.4 v 5.6 p <0.001)

Conclusion: Our results show that there was no evidence of an increase in the severity of sleep disturbance during the 1st wave of the COVID-19 pandemic in the UK in contrast to what numerous surveys have suggested. Indeed, we found that people signing up to Sleepstation's online dCBTi course during the 1st wave of the pandemic had statistically significant better subjective sleep, although they had a higher level of daytime sleepiness than those in the same period a year previously. Although statistically significant, our results do not demonstrate a clinically relevant difference between the two cohorts. It is also interesting that despite the age-related impact of COVID-19, there was no significant difference in the age of the patients. Thus, in contrast to the survey data, we found no evidence for a worsening of sleep during the 1st wave of the pandemic.

Support (if any):

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CHANGES IN OBJECTIVELY-MEASURED ADOLESCENT SLEEP AND LIGHT EXPOSURE DURING THE COVID-19 PANDEMIC

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Introduction: U.S. adolescents have high rates of insufficient sleep. School closures and stay-at-home orders were implemented to mitigate disease spread during the Coronavirus 2019 (COVID-19) pandemic. Without the restriction of imposed early school start times, we hypothesized that adolescents would have longer, later, and less variable sleep compared to pre-COVID-19. We further hypothesized these changes would be associated with increased and later light exposure.

Methods: High school students age 14–19 years with <7h sleep on school nights completed two weeks of at-home monitoring. The Pre-COVID-19 week took place between October 2018-February 2020 and the COVID-19 week occurred in May 2020 during statewide stay-at-home orders. Participants wore an accelerometer to assess sleep and light exposure while completing a concurrent sleep log. Paired-samples t-tests examined differences in sleep and light between Pre-COVID-19 and COVID-19. Pearson correlations assessed associations between change in sleep and change in light.

Results: Participants (N=16) were 16.5 ±1.2-years-old at Pre-COVID-19, 70.6% female, 68.8% White, and 25.1% Hispanic. Youth were participating in online learning due to in-person school closures and only 2 participants (14.3%) had a set start time, while the remainder reported learning per their own schedule. Youth obtained approximately one hour more weekday sleep per night during the COVID-19 week compared to Pre-COVID-19 (p<0.001). Bed and waketimes were significantly delayed on weekdays and weekends during COVID-19 compared to Pre-COVID-19 (p< 0.01). The greatest change was a delay in weekday waketime of 2.9□0.9h (p<0.001). Social jetlag during COVID-19 was reduced by 1/3 compared to Pre-COVID-19 (p=0.02). Average 24h lux levels were 2.5x higher during the COVID-19 week compared to Pre- COVID-19 (p=0.008). Change in average lux and timing of light were not significantly associated with change in sleep duration or timing.

Conclusion: An unintended effect of the switch to online learning may have been affording adolescents the opportunity to obtain longer and more regular sleep. Understanding the impact of these changed sleep behaviors on daytime functioning, academic performance, and health outcomes is particularly urgent as schools plan for the remainder of the academic year and eventual return to in-person learning.
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COVID-19 INSTRUCTION STYLE (IN-PERSON, VIRTUAL, HYBRID), SCHOOL START TIMES, AND SLEEP IN A LARGE NATIONWIDE SAMPLE OF ADOLESCENTS

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Introduction: The COVID-19 pandemic significantly disrupted how and when adolescents attended school. This analysis used data from the Nationwide Education and Sleep in TEens During COVID (NESTED) study to examine the association of instructional format (in-person, virtual, hybrid), school start times, and sleep in a large diverse sample of adolescents from across the U.S.
Methods: In October/November 2020, 5346 nationally representative students (grades 6–12, 49.8% female, 30.6% non-White) completed online surveys. For each weekday, participants identified if they attended school in person (IP), online-scheduled synchronous classes (O/S), online-no scheduled classes (asynchronous, O/A), or no school. Students reported school start times for IP or O/S days, and bedtimes (BT) and wake times (WT) for each applicable school type and weekends/no school days (WE). Sleep opportunity (SlpOpp, total sleep time proxy) was calculated from BT and WT. Night-to-night sleep variability was calculated with mean square successive differences.
Results: Significant differences for teens' sleep across instructional formats were found for all three sleep variables. With scheduled instructional formats (IP and O/S), students reported earlier BT (IP=10:54pm, O/S=11:24pm, O/A=11:36pm, WE=12:30am), earlier WT (IP=6:18am, O/S=7:36am, O/A=8:48am, WE=9:36am), and shorter SlpOpp (IP=7.4h, O/S=8.2h, O/A=9.2h, WE=9.2h). Small differences in BT, but large differences in WT were found, based on school start times, with significantly later wake times associated with later start times. Students also reported later WT on O/S days vs. IP days, even with the same start times. Overall, more students reported obtaining sufficient SlpOpp (>8h) for O/S vs. IP format (IP=40.0%, O/S=58.8%); when school started at/after 8:30am, sufficient SlpOpp was even more common (IP=52.7%, O/S=72.7%). Greater night-to-night variability was found for WT and SlpOpp for students with hybrid schedules with >1 day IP and >1 day online vs virtual schedules (O/S and O/A only), with no differences in BT variability reported between groups.
Conclusion: This large study of diverse adolescents from across the U.S. found scheduled school start times were associated with early wake times and shorter sleep opportunity, with greatest variability for hybrid instruction. Study results may be useful for educators and policy makers who are considering what education will look like post-pandemic.
Support (if any):

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AGE IS ONLY A NUMBER: TREATMENT MODALITY PREFERENCES IN A RANDOMIZED CONTROLLED TRIAL OF CBTI IN OLDER ADULTS

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Introduction: Use of telemedicine platforms for conducting CBTI has the potential to reach more patients than in person treatment alone. While CBTI has been shown to be effective in older adults, questions about proficiency with technology and preference for treatment modality have not been addressed.
Methods: Baseline data from participants in the RCT of the Effectiveness of Stepped-Care Sleep Therapy In General Practice (RESTING) study were used. Analyses compared CBTI treatment modality preference (in person, online [video platform], no preference) across the following variables: insomnia severity (Insomnia Severity Index; ISI), depression (Geriatric Depression Scale; GDS), cognitive functioning (telephone-based cognitive screen) and internet proficiency (IP; assessing comfort with and frequency of internet use). Data collected prior to the pandemic-shut down (March 2020) were utilized for the primary analysis of treatment preference; n=71, mean age = 62.5 (SD = 8.1); 64.8% female; treatment preferences: in person (33.8%), no preference (25.4%), online (40.8%). A secondary analysis compared IP data from participants with baseline data from pre-pandemic (Nov 2019-Feb 2020, n=71), early pandemic (March-June 2020, n=28), and late pandemic (the most recent four months of enrollment, July 2020-Nov 2020, n=40) periods.
Results: Pre-pandemic, age was not significantly associated with treatment modality preference, nor any baseline clinical characteristics or demographic variables (p's >.01). Only 'comfort' and 'comfort+frequency' scores from the internet proficiency measure differed significantly between treatment preference groups (p's<.002). Post-hoc analyses revealed the online group had significantly higher comfort and comfort+frequency scores than the in person group (p's<. 003). Comparing data from pre-pandemic, early pandemic, and late pandemic, frequency of internet use and comfort+frequency with internet use differed across groups (p's <.004). Post-hoc comparisons revealed frequency of internet use scores were higher in the late pandemic compared to pre-pandemic (p=.003).
Conclusion: These findings suggest that comfort using technology, but not age or clinical characteristics, is associated with treatment modality preference for patients with insomnia who are enrolled in a technology-based clinical trial of CBTI. As proficiency in use of technology increases, for example, during and following the pandemic, one can expect that telemedicine will be an increasingly viable approach to providing CBTI among older adults.
Support (if any): 1R01AG057500

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IMPACT OF REMOTE CONTINUOUS POSITIVE AIRWAY PRESSURE SET-UP ON TREATMENT USAGE AND EFFECTIVENESS

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Introduction: Initiating treatment with continuous positive airway pressure (CPAP) traditionally relies on in-person visits with trained

therapists to provide hands-on instruction regarding CPAP usage and mask fit. To overcome geographic barriers and reduce COVID-19 transmission, health systems increasingly rely on remote set-ups of mailed equipment. Despite a strong rationale for the mailed approach, relative effectiveness is unclear.

Methods: Our VA medical center shifted from in-person to mailed CPAP dispensation during the COVID-19 pandemic in March 2020. Using VA administrative and wireless CPAP usage data, we assembled a cohort of patients with newly diagnosed obstructive sleep apnea (OSA) who initiated CPAP for the first time from July 2019 to August 2020. Our primary outcome was mean nightly usage over the first 90 days. We compared patients with in-person vs. mailed CPAP dispensation using generalized linear models adjusted for age, gender, race, and Charlson Comorbidity Index. Among patients with >1 hour of overall usage, we compared secondary outcomes of leak, apnea hypopnea index (AHI), and obstructive/central apnea indices.

Results: We identified 693 patients with newly diagnosed OSA whose CPAP was provided in-person and 296 who had CPAP mailed. Nightly usage in the first 90 days was modest in both groups (in-person: 149.7, mailed: 152.9 min/night), and we did not detect a difference in adjusted models (+7.6 min/night, 95%CI -13.6–28.8). We also did not detect a difference in 95th percentile leak (-1.2 liter/minute, 95%CI -3.3-0.9). Device-detected AHI was relatively low overall (in-person: 3.2, mailed: 4.1 events/hour), but was greater in the mailout group (+1.0/hour, 95%CI 0.2–1.7). AHI differences appeared to be driven by obstructive (+0.5/hour, 95%CI 0.2–0.8) but not central events (-0.1, 95% CI -0.2–0.4). Risk of AHI>5 was comparable between groups (in-person: 17.3%, mailed: 19.0%, OR 1.2, 95%CI 0.8–1.7).

Conclusion: We were able to switch from an in-person to a mail-based system of CPAP initiation without a change in CPAP adherence or mask leak. While AHI was slightly greater in the mailed group, the clinical significance of this finding is unclear. Future work will need to evaluate the impact of remote CPAP dispensation on patient-centered outcomes.

Support (if any): VA Health Services Research and Development, CDA 18–187

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PREDICTORS OF SLEEP HEALTH AMONG OLDER ADULTS DURING THE INITIAL MONTHS OF THE COVID-19 PANDEMIC

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Introduction: Since the first COVID-19 case was reported in January 2020 in the United States, there have been more than 18.8 million cases and 330,000 deaths. In order to minimize the risk of potential COVID-19 transmission, many states instituted stay at home orders and closed churches, gyms, and other places that older adults often participate in social gatherings. Little is known about sleep health among older adults during this time. The purpose of this study was to examine the relationship between older adult's personal factors, health behaviors, and sleep health during the initial months of the Covid-19 pandemic.

Methods: Adults age 60 and older participated in an online anonymous survey recruited through email lists of community senior organizations and university alumni using a snowball approach. Personal factors included age (years), gender (female=0, male=1), living situation (living alone=0, living with others=1), education (≤12 years = 0, >12 years = 1), and income (75000=1), and depressive symptoms (CESD-10). Health Behaviors included moderate physical activity (0=none, 1=yes), smoking (0=no, 1=yes), drinking (number of drinks). Sleep Health was assessed using the multidimensional SATED scale (Satisfaction, Alertness, Timing, Efficiency, and Duration). Backward stepwise regression analysis was used to test if personal factors and health behaviors significantly predicted participants' sleep health.

Results: Participants included 509 adults (392 Females; mean age=75.6 years; SD=5.0; range 63–93 years). The majority were white (n=466; 92%) and 93% (n=471) had a college education. Seventy-four percent (n=71) participated in moderate exercise, 94% (n=478) did not smoke, and 58% (n=286) did not report drinking alcohol. Sleep Health was variable with 179 (36%) reporting poor sleep health (mean=7.4; SD=2.1). Regression results indicated that gender, years of education, living situation, income, depressive symptoms and moderate exercise explained 17% of the variance in sleep health (R2=0.169, F,6=14.4, p=0.000).

Conclusion: These findings suggest that many older adults experienced poor sleep health associated with depressive symptoms and exercise participation during the initial months of the pandemic. Future studies should examine the long-term effects of the pandemic on the sleep health of older adults.

Support (if any): Saint Louis University COVID-19 Rapid Response Fund (OpenWater 1804).

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PREVALENCE OF SLEEP DISTURBANCES IN PATIENTS WITH CHRONIC NON-CANCER PAIN: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: In individuals with chronic pain, sleep disturbances have been suggested to increase suffering, perception of pain, and to negatively affect long-term prognosis. This systematic review and meta-analysis aims to determine the pooled prevalence of sleep disturbances in chronic non-cancer pain patients with no other sleep disorders, using the patient-rated questionnaires Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI).

Methods: Multiple databases were searched for studies reporting the prevalence of sleep disturbances in chronic pain patients. Chronic pain was defined as pain >3 months. Comorbid sleep disorders such as sleep disordered breathing and restless leg syndrome were excluded. Sleep disturbances were defined using the PSQI cutoff of > 5 (poor sleep quality) and ISI ≥ 8 (subthreshold to clinical insomnia). The meta-analysis was conducted to examine the pooled prevalence of PSQI and ISI data using the inverse-variance random-effects model and to examine mean differences in PSQI scores.

Results: The systematic search resulted in 25,486 articles and 20 were included for analysis. In 12 studies using PSQI, the pooled prevalence of sleep disturbance was 75.3% among 3,597 chronic pain patients (mean age 53 ± 12 years; 74% female). In eight studies using ISI, the pooled prevalence was 72.9% among 2,578 chronic pain patients (mean age 63 ± 12 years; 57% female). The meta-analysis showed a significant mean difference of 2.75 ($p < 0.001$) in the global PSQI score between the chronic pain group versus the non-chronic pain group. The meta-analysis also showed a significant mean difference in the scores of four of seven PSQI components: sleep latency, sleep efficiency, sleep duration, and sleep disturbances ($p < 0.05$).

Conclusion: In chronic pain patients, the pooled prevalence of sleep disturbances as measured by PSQI (75.3%) and ISI (72.9%) studies was much higher than those reported for the general population. The relatively high prevalence of sleep disturbances in chronic pain patients emphasizes the importance of further characterizing the relationship between sleep and chronic pain.
Support (if any):

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IMPACT OF OBSTRUCTIVE SLEEP APNEA AND POSITIVE AIRWAY PRESSURE THERAPY ON COVID-19 OUTCOMES

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Introduction: We explore the impact of obstructive sleep apnea (OSA) and positive airway pressure (PAP) therapy on novel coronavirus (COVID-19) infection rate and severity.
Methods: Retrospective analysis was performed utilizing a database of patients evaluated by Kaiser Permanente Southern California sleep medicine between 2015–2020 (includes sleep study, daily PAP, and electronic health record data.) Adult patients were analyzed if: on March 1, 2020 patient was alive, had ≥1 month health-plan enrollment, and had sleep diagnostic or PAP data. PAP adherence was calculated between March 1, 2020 to COVID-19 confirmation, death, disenrollment or study end date (July 31, 2020), whichever came earlier. COVID-19 outcomes were evaluated based on OSA status and PAP adherence: patients with PAP <2 hours/night were considered "untreated"; ≥2 hours/night were "treated"; 2–3.9 hours/night were "moderately-treated"; ≥4 hours/night were "well-treated". Apnea hypopnea index (AHI) defined OSA severity. Multiple logistic regression evaluated the association of various demographic/clinical factors.
Results: Of 81,932 patients (39.8% female, age 54.0±14.9 years) analyzed, 1493 (1.8%) had COVID-19 with 224 (0.3%) hospitalizations and 61 (0.07%) resulting in intensive care or death. Increased severity of "Untreated" OSA was associated with higher COVID-19 rate and lower when "treated" [No OSA 1.7%; Mild 2%; Moderate 2%; Severe 2.4%; OSA unknown severity 2%; Treated 1.4%; p<0.0001]. Better PAP adherence was associated with reduced infection rate ["untreated" 2.1%; "moderately-treated" 1.7%, "well-treated" 1.3%, No OSA 1.7%; p=<0.0001]. Multivariable analysis confirmed increased infection rate with OSA versus no OSA [OR 0.82(0.70,0.96)] and the benefit of good PAP adherence versus "untreated" ["moderately-treated" OR 0.82 (0.65, 1.03); "well-treated" OR (0.69 (0.59, 0.80)]. Increased infection rate was also associated with obesity, higher Charlson Comorbidity score, Black and Hispanic ethnicities, and Medicaid enrollment; increasing age was associated with reduced infection rate. Separate multivariable analysis showed dose-response association of OSA severity on infection rate [Mild OR 1.21 (1.01,1.44 95%CI); Moderate-Severe OR 1.27 (1.07,1.51) versus no OSA]. Neither OSA presence nor PAP adherence significantly impacted rate of hospitalization nor intensive care or death.
Conclusion: Significant associations emerged with OSA increasing and PAP therapy reducing COVID-19 infection rate. Findings support continued PAP use during the pandemic.
Support (if any): AASM Foundation SRA: 205-SR-19

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SLEEP APNEA SEVERITY AND COVID-19 HOSPITALIZATION OUTCOMES: INTERIM ANALYSIS

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Introduction: Millions worldwide have been infected with COVID-19. Risk factors for poor outcomes include older age, obesity, cardiovascular disease, diabetes, COPD, and minority ethnicity. The impact of sleep apnea (OSA) on COVID-19 illness remains a topic of ongoing research. The association seems plausible as OSA shares common risk factors with COVID-19 comorbidities. The aim of our study is to investigate if the severity of OSA correlates with COVID-19 hospitalization outcomes.
Methods: The study is an observational retrospective electronic medical chart review of patients admitted to the Yale Health system for COVID-19 illness, who have an ICD medical history diagnosis of sleep apnea. Subjects with an available sleep study were grouped based on AHI severity. Composite outcome was determined by mortality or critical illness (ICU admission, mechanical ventilation, High-Flow nasal cannula or noninvasive ventilation). Interim analysis was conducted with data from 256 patients. Logistic regression was performed to calculate OR associated with the primary outcome comparing mild versus moderate-severe OSA groups.
Results: The sample of 256 patients included 50% females, with a median age of 64 (IQR,55–73) and BMI of 36 (IQR,30–41). Race distribution composed of 45% Whites and 40% African-Americans with 18% identifying as Hispanic. Overall mortality rate was 16%. Median length of stay (LOS) was 9 days (IQR,5 -15). 155 patients had a recorded AHI with a median of 26/hour (IQR,11–51) grouped into mild (34%), moderate (20%) and severe (45%) disease. Severe sleep apnea had the highest mortality rate of 19% and median LOS of 10 days (IQR,5- 16) compared to moderate (6% mortality,9 days (IQR,6–14)) and mild (17% mortality,6 days (IQR,4–11)) disease; differences were not statistically significant. Univariate logistic regression analysis demonstrated no significant difference in the composite outcome for mild versus moderate-severe OSA groups (OR=1.2; 95% CI:0.58–2.32).
Conclusion: Severe OSA appeared to have a trend towards an association with higher mortality versus moderate but not mild disease. Comparing moderate-severe disease to a reference group of mild disease did not demonstrate a significant difference in our composite outcome of death or critical illness. Additional subject recruitment and re-analysis are needed to confirm the findings of this interim analysis.
Support (if any): N/A

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HOW DOCTORS SLEEP DURING THE COVID-19 PANDEMIC: A SURVEY

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Introduction: Sleep deprivation is known amongst doctors (working hours of doctors in developing countries are long and not tightly regulated) and the COVID-19 pandemic may make it worse. We conducted this survey to assess the quantitative and qualitative effects of this pandemic on the sleep of doctors.
Methods: A survey was created on Google Forms and it was circulated / sent through WhatsApp for voluntary participation amongst several groups of doctors and individually as well.
Results: We received 304 responses from doctors of various specialties, cadres and background. Our results showed that 52% of them were involved in direct clinical care of COVID-19 patients. 55.8% doctors reported changes in sleep pattern and 37.2% reported reduced duration of sleep, as compared to the time before the pandemic. More than 50% of them slept for less than 7 hours a night since the beginning of the pandemic. 37% had difficulty falling asleep and maintaining sleep. 30% had difficulty in concentration and functioning during day-time. Non-refreshing sleep was experienced by 36.3% of them

and 18.8% of physicians had recollected having COVID-19 related dreams. 33% doctors' last thought before sleep and first thought after waking up were about COVID-19. 36% doctors looked for information about COVID-19 on media immediately before going to sleep and immediately after waking up. More than 60% doctors started meditation, exercise, yoga or relaxation techniques for getting better sleep.
Conclusion: A further decline in duration and quality of sleep due to the COVID-19 pandemic amongst already sleep-deprived doctors may be detrimental not only to their own health but for patient-care also.
Support (if any):

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COMPARISON OF TELEMEDICINE AND IN-PERSON PSYCHOTHERAPY FOR CPAP ADHERENCE IN A POPULATION OF VETERANS

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Introduction: Obstructive sleep apnea (OSA) is the second most common sleep disorder among Veterans and carries risk of serious health complications when untreated. The gold standard for OSA treatment is Positive Airway Pressure (PAP). However, adherence to PAP therapy is chronically low. Interventions to enhance adherence include education, practical support, and psychotherapy. Cognitive behavioral therapy and motivational interviewing have been shown to improve CPAP usage by approximately 1 hour per night. Telemedicine-delivered CPAP education and telemonitoring-with-feedback has demonstrated improved adherence in patients with OSA. Our study evaluated the effectiveness of a telemedicine group psychotherapy intervention for Veterans diagnosed with OSA and found to be nonadherent to CPAP therapy. The intervention is delivered in four weekly 60-minute sessions.
Methods: We identified a cohort of 29 patients who participated in the intervention via telemedicine from April 2020 - September 2020 (Telemedicine Psychotherapy cohort). The cohort was compared to a historical control of 35 patients who participated in the in-person group psychotherapy from April 2019 - September 2019 (In-Person Psychotherapy cohort). Through retrospective chart review, we analyzed baseline and post-intervention data from both cohorts. Demographics collected included age, sex, BMI, ethnicity, zip code, as well as medical and mental health comorbidities. Data collected from the medical record included: OSA severity, pre- and post-psychotherapy 90-day average nightly CPAP usage (in minutes), number of psychotherapy classes attended (out of 4) and number of sleep clinic visits at 90-days post-psychotherapy. We used descriptive statistics to provide summary data of this sample and t-test to evaluate Veteran's average CPAP usage per night and number of sleep clinic visits at 90-days post-psychotherapy between cohorts.
Results: Compared to a cohort of in-person group psychotherapy to improve CPAP adherence, a telemedicine-based cohort demonstrated improvement in 90-day average nightly CPAP usage by an average of 76 minutes per night. (p=0.08) Additionally, patient engagement with the sleep clinic at 90 days following completion of telemedicine psychotherapy was significantly higher compared to in-person psychotherapy (p<0.001).
Conclusion: In a haphazardly-collected convenient sample of veterans during the COVID-19 pandemic, telemedicine psychotherapy led to improved CPAP usage. Veterans who underwent telemedicine intervention also significantly increased engagement with the sleep clinic.
Support (if any):

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CONTRIBUTION OF PULMONARY DISEASES TO COVID-19 MORTALITY IN A DIVERSE COMMUNITY OF NEW YORK CITY

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Introduction: New York City has been one of the largest epicenters of the COVID-19 pandemic. This provided a wealth of data to examine the characteristics of COVID-19 patients in this multi-ethnic city, while assessing the contributions of cardio-metabolic burden and pulmonary conditions as potential "at-risk" conditions for COVID-19. We assessed the relative contribution of common upper and lower airway pulmonary diseases in determining the likelihood of COVID-19-related mortality independent of other medical conditions, health risks, and sociodemographic factors.
Methods: We analyzed data from one of the largest US-based case series of patients with COVID-19, captured from an academic health network in NYC. A total of 11,512 hospitalized patients (March 2-May 24, 2020) were tested with 4,446 (38.62%) receiving a positive diagnosis for COVID-19. EHR queries yielded age at time of testing, sex, race/ethnicity aggregated as non-Hispanic black, Asian and Hispanic referenced to non-Hispanic white; cardio-metabolic conditions (hypertension, hyperlipidemia, diabetes, obesity, peripheral artery disease, and coronary artery disease); pulmonary disease (e.g., COPD, sleep apnea, or asthma); autoimmune disease; and cancer. Mortality was based on the patient state (alive or deceased) at the moment of discharge. We included only patients who had been discharged alive or had expired. Anaconda Python 3.7 was used to perform all analyses.
Results: Among patients testing positive, 959 (21.57%) died of COVID-19-related complications at the hospital. Multivariate-adjusted Cox proportional hazards modeling showed mortality risks were strongly associated with greater age (HR=1.05; 95%CI:1.04–1.05), ethnic minority (HR=1.26; 95%CI:1.10–1.44), low household income (HR=1.29; 95%CI:1.11, 1.49), and male sex (HR=0.85; 95%CI:0.74, 0.97). Higher mortality risks were also associated with a history of COPD (HR=1.27; 95%CI:1.02–1.58), obesity (HR=1.19; 95%CI:1.04–1.37) and peripheral artery disease (HR=1.33; 95%CI:1.05–1.69). We observed a significantly higher rate of COVID-19 cases (43.8% vs 39.6%, p<0.05) among patients with sleep apnea (7.72%). However, they did not have a significantly higher mortality rate (13.0% vs 11.8%, NS), although they experienced a longer hospital stay (7.1±7.7 vs 6.1±7.5, p<0.01).
Conclusion: Patients with COPD had the highest odds of COVID-19 mortality. Sociodemographic factors including increased age, male sex, low household income, ethnic minority status were also independently associated with greater mortality risks.
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SLEEP LATENCY, PRE AND PERI-COVID-19 EXPERIENCES AND PTSD SYMPTOMS: RESULTS FROM THE NYU COVID-19 MENTAL HEALTH STUDY

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Introduction: An effective response to the COVID-19 pandemic has been the decision to subject individuals residing in New York City to quarantine rules in order to reduce the spread of the virus. As might have been expected, restriction of usual daily activities would affect individuals' sleep-wake patterns. It is also known that exposure to traumatic experiences can also engender sleep disturbances, most notably in their ability to initiate sleep. This study investigated the associations between sleep onset latency (SOL), pre and peri-COVID-19 exposure and symptoms of posttraumatic stress disorder (PTSD) among New Yorkers.
Methods: 541 individuals (female = 373(69%); mean age=40.9) were recruited during the summer and fall of 2020 in New York City to participate in the NYU-COVID-19 Mental Health Study. Participants provided sociodemographic data and were also asked to respond to the COVID-19 quarantine experiences, comprised of seven binary questions, the PTSD Checklist-PCL-5, and the Pittsburg Sleep Quality Index. Descriptive and linear regression analysis were performed to explore associations of scores on the COVID-19 quarantine experience with PTSD and sleep data. All analyses were performed using SPSS 25.0
Results: Regression analyses revealed that SOL emerged as the strongest independent predictor of PTSD symptoms [B(t) = −.630(12.7); p < .001]; factors adjusted in the model included pre and peri-covid-19 factors such as age, sex, job type, and quarantine experience. Analyses assessing potential interaction effect revealed that quarantine experience did not affect the relationship between SOL and PTSD [B(t) = .086(.831); p = >.005]. The other sleep factors in the model did not yield significance. sleep duration had a weak correlation with quarantine, it was not found to be a predictor of PTSD.
Conclusion: We observed that SOL was the most important determinant of PTSD symptoms among individuals exposed to COVID-19. This is consistent with other findings suggesting that a sizable proportion of individuals exposed to pandemics are likely to experience sleep disturbances. It is plausible that quarantine might lead to increased daytime naps, which may impact SOL. Further research is needed to better understand the association of SOL and PTSD as a result of Covid-19.
Support (if any): K07AG052685, R01MD007716, R01HL142066, T32HL129953, K01HL135452, R01HL152453

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SLEEP EDUCATION AND SLEEP OUTCOMES IN THE TIME OF COVID-19 IN MEXICO

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Introduction: This study examines computer-mediated sleep education for health providers enrolled in a certified diabetes educator program in November 2020 in Mexico.
Methods: Data derived from pre/post ratings assessed knowledge of obstructive sleep apnea (OSA), insomnia, restless legs syndrome (RLS), short sleep duration (SSD), circadian rhythm disorders (CRD), and drowsy driving (DD) on a 5-point Likert-like scale, and five true/false questions regarding misconceptions about sleep. Outcomes included self-reported sleep problems among providers since the onset of the March 2020 Covid-19 surge in Mexico. Pre/post means were compared with paired t-tests using SPSS (V25) with significance set at p<0.05.
Results: Volunteer participants (N=23; 83% women; 52% nutritionists; 48% health providers) were recruited from the fall semester 2020 diabetes educator certificate program. Means with standard deviations showed significant learning for all sleep disorders following the training (OSA: 3.1±1.0 to 4.4±0.78; Insomnia: 3.2±0.85 to 4.3±0.82; RLS: 2.1±1.2 to 4.2±0.95; SSD: 2.7 ±1.1 to 4.4±0.72; CRD: 2.6±1.2 to 4.4±0.73; DD: 2.6±1.1 to 4.4±0.78, all p<.0001). The total pre- to post-scores (Range=0 to 30) for sleep disorders moved from 16.3±5.7 to 26.3±4.4, p<.0001. Participants demonstrated improved, but borderline significant findings regarding misconceptions about sleep from pre-to post-testing, p=.07. Of the 23 respondents, 18 (78%) reported sleep problems specific to the onset of the Covid-19 pandemic in Mexico. Of the 18 providers, 13 reported insomnia symptoms, while five indicated short sleep due to double shift work, anxiety and depression, or poor sleep quality.
Conclusion: Participants (78%) reported sleep problems; particularly insomnia associated with anxiety, depression, poor sleep quality and extended shift work since the onset of the Covid-19 pandemic. Findings are consistent with global studies of Covid-19 and sleep of health care workers. Online participants' significant learning for all sleep disorders was coherent with in-class learners (N=173). Pre-to-post analyses of misconceptions about sleep, particularly sleep needs for adults and that daytime sleep can make up for lack of nighttime sleep, however, were not significant for these learners compared to the in-class learning groups.
Support (if any): N/A

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CHANGES IN ADOLESCENT SLEEP HABITS DURING THE COVID-19 PANDEMIC

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Introduction: During the COVID-19 pandemic, adolescents have experienced significant lifestyle changes. With an increase in technological dependency and changes in school formats, sleep behaviors may be altered. As individuals with overweight or obesity (OWOB) already report higher rates of sleep issues, they may be particularly at risk during this time. However, to date, there are no data on changes in sleep behavior in adolescents with OWOB during the COVID-19 pandemic.
Methods: Participants included 10 adolescents with BMI ≥85th percentile (Mage=16.30 years, SDage=1.06; 60% male; 70% African American). Prior to the COVID-19 pandemic, participants completed sleep diaries twice per day for one week, noting caffeine intake, bedtime, naps, perceived sleep quality, and media use in bed. Participants then completed sleep diaries again during the COVID-19 pandemic. Five separate paired-samples t-tests assessed differences in sleep behaviors and quality.
Results: A paired-samples t-test demonstrated significantly earlier average bedtime before (M=11:20 PM, SD=55.16 minutes) than during (M=12:29 AM, SD=71.27 minutes) COVID-19 (t(9)=-3.0, p=0.015). A second paired-samples t-test demonstrated lower average media use in bed before (M=11.67, SD=10.97 minutes) than during (M=32.13, SD=27.28 minutes) the COVID-19 pandemic (t(9)=-2.3, p=0.050). No other significant differences were found.
Conclusion: Adolescents engaged in later bedtimes and increased media use in bed during the COVID-19 pandemic. This suggests adolescents' sleep schedules have shifted later during the COVID-19 school year, due to either later wake times associated with virtual schooling or disruption in typical daily schedule as a result of the pandemic. However, no differences were found regarding caffeine intake,

number of naps, and sleep quality. The significant findings regarding later adolescent bedtimes may reflect delayed sleep phase or possibly improved circadian alignment due to delayed school start times and at-home classes. The null findings regarding naps and caffeine intake may be reflective of the stability of daytime sleepiness. While we would expect daytime sleepiness to improve with increased circadian alignment, the effects may be diminished by increased media use in bed and decreased energy expenditure during the day. Given the observed relationships, current sleep hygiene interventions may require a focus on stimulus control and reducing time with media in bed.
Support (if any):

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PEDIATRIC OBSTRUCTIVE SLEEP APNEA (OSA) AND COVID-19-RELATED ADVERSE CLINICAL OUTCOMES

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Introduction: The relationship of OSA and human coronavirus (COVID-19) in the pediatric population is unknown. We postulate that OSA is associated with SARS-CoV-2 positivity and with adverse COVID-19 outcomes in children.
Methods: A retrospective review of 120 consecutive patients (<18 years) with prior polysomnogram (PSG) and COVID-19 testing from the Cleveland Clinic COVID-19 registry was conducted. Using a case control design of SARS-CoV-2 positive and negative pediatric patients, we examined COVID-19 and pre-existing OSA (dichotomized AHI≥1) using logistic (OR,95%CI) regression and as continuous measures: AHI, oxygen(SpO2) nadir, %time SpO2<90%) using linear regression(beta+/-SE). In those positive for SARS-CoV-2(cases only), we assessed the association of OSA and World Health Organization(WHO) COVID-19 clinical outcome composite score (hospitalization, requiring supplemental oxygen, non-invasive ventilation/high-flow oxygen, invasive ventilation/ECMO or death) using Wilcoxon rank sum test for ordinal data.
Results: Cases (n=36) were 11.8±4.4 years, 61% male, 27.8% black and 88.9% with OSA, while 85.7% of controls (n=84) had OSA. OSA was not associated with increased SARS-CoV-2 positivity: OR=1.33(0.40, 4.45,p=0.64). No significant difference between cases and controls for mean AHI 3.7(1.5,6.0) vs 3.5(1.5,7.1),p=0.91,SpO2 nadir 88.6±5.4 vs 89.1±4.4,p=0.58,%time SpO2<90% 0.05[0.00,1.00) vs 0.10 (0.00,1.00, p=0.65) respectively was noted. WHO-7 COVID-19 clinical outcome did not meet statistical significance in relation to OSA due to the low event frequency (p=0.49). Of note, those with OSA vs without OSA had a higher WHO-7 outcome score of 2 vs 0 and prevalence of hospitalization: 12.5 vs 0% respectively. Of hospitalized patients, the following was observed: 23% had moderate/severe OSA vs 4.3% mild OSA, 50% required supplemental oxygen and 25% required intubation/invasive ventilation. No deaths or readmissions were reported. High risk conditions included: 75% obesity, 50% asthma, 25% sickle cell disease and 25% hypoplastic left heart.
Conclusion: In this first report of which we are aware focused on COVID-19 in pediatric OSA, we use a case control design leveraging COVID-19 and sleep laboratory registries. Albeit not statistically significant, pediatric patients with OSA had a higher percentage of worse clinical outcomes. Larger network studies are needed to clarify whether poorer COVID-19 outcomes may be attributable to OSA or modulated via high risk health conditions.
Support (if any):

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OBJECTIVE ASSESSMENT OF INPATIENT SLEEP PATTERNS AND QUALITY: A PILOT STUDY

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Introduction: Sleep disruption is common among hospitalized patients due to psychological, physiological, and environmental reasons including illness, pain, anxiety, invasive interventions, frequent monitoring, and stimuli, especially noise and light. The AASM has published guidelines for the use of actigraphy in the outpatient setting, but there is a paucity of literature evaluating the validity of actigraphy in inpatients. The aim of this study is to evaluate sleep in hospitalized general medicine patients undergoing sleep medicine consultation using actigraphy and qualitative surveys.
Methods: A single-site prospective study in hospitalized medicine patients. Patients were observed with a Fitbit® Charge3 wrist actigraphy device overnight, then administered 7 surveys: Richards-Campbell Sleep Questionnaire (RCSQ), qualitative questionnaires assessing sleep history, sleep hygiene, barriers to sleep, STOP-BANG, Epworth Sleepiness Scale (ESS), and Patient-Health Questionniare-2 (PHQ-2). Actigraphy data including total sleep time, slow wave sleep time, and number of awakenings was compared with patient-reported data.
Results: In preliminary analysis, six patients met inclusion criteria and underwent sleep medicine consultation, overnight actigraphy, and completed 7 surveys. Based on subjective sleep history questionnaires, average total sleep time was 437 + 215 minutes. Actigraphy revealed average total sleep time was 228 + 80 minutes with an average of 3.6 nocturnal awakenings. Increased number of awakenings on actigraphy was not correlated with increased number of awakenings by survey. The most frequently reported barriers to sleep on patient surveys were pain and being woken up for labs or vital signs. The average STOP-BANG score was 6 out of 8 and average ESS was 14 out of 24.
Conclusion: Restorative sleep warrants consideration alongside complex medical care during hospitalization. Patients experience decreased total sleep time and increased number of awakenings while in the hospital compared with their subjective estimates of sleep at home. Actigraphy provides a non-invasive and reliable way to monitor some sleep parameters in the inpatient setting. An elevated STOP-BANG score could represent sleep disordered breathing and impact perceptions of sleep quality. Patient-identified barriers to sleep are targets for quality improvement. Future studies should compare inpatient actigraphy data to polysomnographic data and the effect of sleep-directed interventions on sleep quality in the hospital.
Support (if any):

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AN ANALYSIS OF OBJECTIVE AND SUBJECTIVE SLEEP AND INFECTION SYMPTOMS OF MEDICAL PERSONNEL WORKING THROUGH THE COVID-19 PANDEMIC

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Introduction: There is a well-established connection between sleep and the immune system, and in the midst of a global pandemic, it is vital to understand the relationship between COVID-19 symptomatology and sleep. While our communities practice safety protocols, medical personnel working on the COVID-19 response

effort are at high risk for exposure and contraction. This creates an urgent need to better understand whether sleep may contribute to COVID-19 symptom onset, severity, and recovery. This study examined the relationship between subjective and objective sleep during infection.

Methods: Fifty volunteers (age 35.15±9.97) considered high risk for COVID-19 participated in the study. The sample consisted mostly of medical personnel (93.27%) working through the pandemic. Over six months, participants completed monthly surveys and daily logs via Qualtrics. These surveys included questions about sleep, infection symptoms, COVID-19 tests and diagnoses, and mood. Wrist-worn actigraphy was collected continuously throughout the study. Sleep duration, latency, wake after sleep onset, and efficiency were processed using Philips Actiware 6.0. Actigraphy and survey data were analyzed using SPSS v. 25.

Results: Sixty-two percent of participants experienced infection symptoms. Those experiencing symptoms were significantly more likely to report having poorer sleep quality t(255.59)=5.78, p=<.001, poorer mood upon waking t(258.03)=6.53, p=<.001, feeling less alert upon waking t(255.61)=4.56, p=<.001, and spending more time awake at night t(2.66.98)=-7.29, p=<.001. Results showed that compared to those asymptomatic, participants with cough t(2164)=2.07, p=.039, diarrhea t(2161)=2.51, p=.012, and headache t(106.18)=7.05, p=<.001 all had significantly less total sleep time, while those with body aches spent significantly more time awake at night t(2164)=2.10, p=.036.

Conclusion: This preliminary examination of the data broadly suggests that medical personnel experiencing infection symptoms may have difficulty obtaining adequate sleep. Further, specific infection symptoms may share a stronger relationship with key sleep parameters than others. These findings support further testing of the bi-direction relationship between infection symptoms and sleep. Results from this research will contribute to enhancing prevention, detection, and treatment guidance related to future domestic and globally-experienced infections.

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ASSOCIATIONS OF SLEEP QUALITY AND BURNOUT IN CLINICIANS DURING THE COVID-19 PANDEMIC

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Introduction: Clinicians have faced unprecedented challenges in care delivery during the COVID-19 pandemic due to increases in patient volume/acuity, alongside fears of COVID-19 exposure. Increased burnout rates are associated with chronic health condition risk and adverse organizational outcomes. It remains unclear whether sleep is associated to burnout in clinicians treating COVID-19 patients.

Methods: A cross-sectional electronic survey was distributed via email across 3 hospital listserves from September to November, 2020. Clinicians delivering direct care to COVID-19 patients were eligible. Clinician burnout was measured using a single item from AHRQ's Mini-Z survey. We assessed sleep using the Pittsburgh Sleep Quality Index (PSQI). Binary logistic regressions were used to determine the relationship between PSQI global score (global sleep quality) and burnout, controlling for age, race/ethnicity, gender, length of time employed, whether clinical role changed during COVID-19, and anxiety. In a separate model, we investigated the association between burnout and independent PSQI subcomponents: 1) sleep duration ("Hours of sleep per night"), and 2) subjective sleep quality ("How would you rate your sleep quality overall") entered together, with the above covariates.

Results: The final sample included 315 clinicians, predominantly nurses (57% White, 15% Hispanic/Latino, 89% female). Burnout symptoms were reported by 61.6%, and poor global sleep quality (PSQI global score >5) in 84.4% of participants. Poor global sleep quality (PSQI global score >5 vs. ≤5) was significantly associated with the presence of burnout symptoms (OR: 2.52, 95% CI: 1.20–5.28, p=0.015). In the secondary model, self-reported sleep quality (rating of fairly or very bad vs. rating of fairly or very good) was significantly associated with burnout (OR: 4.13, 95% CI: 2.33–7.32, p<0.05), whereas short sleep duration (<6 h vs. ≥6 h) was not (OR: 0.726, 95% CI: 0.41–1.30, p=0.28).

Conclusion: Poor sleep quality is common and associated with increased burnout in clinicians delivering care to COVID-19 patients. Interestingly, sleep quality appears to be more strongly related to burnout than sleep duration. Increased evidence about the negative implications of poor sleep and burnout are emerging. Interdisciplinary efforts aimed at promoting effective sleep quality in clinicians during this pandemic may lead to improvements in long-term clinician physical and psychological health.

Support (if any):

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LONGITUDINAL STABILITY OF SLEEP AND HEALTH CORRELATES IN ADULTS WITH AUTISM SPECTRUM DISORDER

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Introduction: Individuals with Autism Spectrum Disorder (ASD) experience sleep disturbances to a greater degree than the general population. The majority of research investigating sleep disturbances in ASD has focused on children and adolescents. The aim of the current study was to determine the stability and health correlates of self-reported sleep disturbances in adults with ASD.

Methods: Participants included 55 adults with ASD recruited from state-funded Pennsylvania programs (31.2±7.6 years old, 80% male, 10.9% minority). Patient-Reported Outcomes Measurement Information System (PROMIS) measures assessing Sleep Disturbances, Sleep-Related Impairment, Fatigue, Anxiety, Depression, Anger, and Physical Health, were completed at baseline and every 90 ± 14 days over a 2-year period. Intraclass correlation coefficients (ICC) were calculated for each sleep outcome, and interpreted as 0.00–0.20="poor stability," 0.21–0.40="slight stability," 0.41–0.60="moderate stability," 0.61–0.80="substantial stability," and 0.81–1.00="almost perfect stability" across the first three time-points. Linear mixed models examined the independent association of sleep disturbances, sleep-related impairment, and fatigue on anxiety, depression, anger, and physical health over the two-year period.

Results: Sleep-related impairment (ICC=0.73) and fatigue (ICC=0.64) were substantially stable, while sleep disturbances were moderately stable (ICC=0.58). All three sleep-related outcomes were independently associated with anxiety (sleep-related impairment p=0.012; sleep disturbance p<0.001; fatigue p=<0.001) and anger (sleep-related impairment p=<0.001; sleep disturbance p=0.001; fatigue p<0.001) across the two-year period. Sleep disturbance (p=<0.001) and fatigue (p<0.001), but not sleep-related impairment (p=0.267), were associated with depression across the two-year period. In contrast, none of the sleep-related outcomes (sleep-related impairment p=0.285; sleep

disturbance p=0.250; fatigue p=0.709) were associated with physical health over time.
Conclusion: Measures of sleep-related impairment, fatigue, and sleep disturbance remained stable over time, suggesting that they can provide clinicians and researchers with a brief, accurate, and reliable way to assess patient-reported sleep outcomes in adults with ASD. Furthermore, given the stability of these sleep measures and their independent association with elevated mental health outcomes, there is a need for evidence-based treatments targeting sleep difficulties and associated symptomology in adults with ASD, a particularly underserved population.
Support (if any): Pennsylvania State Bureau of Autism Services through the Autism Services, Education, Resources, and Training (ASERT) grant

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SLEEP HEALTH IN THE YOUNG ADULT CLINIC: A RETROSPECTIVE OBSERVATIONAL COHORT STUDY

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Introduction: The Toronto Academic Pain Medicine Institute (TAPMI) Young Adult Clinic (YAC) was developed to offer transition services for clients aged 17–25 with persistent pain. It was noticed that YAC patients had significant problems with their sleep and the program was expanded in January 2019 by including a sleep medicine specialist for systematic evaluation of sleep health. Long-term sleep disruption has been associated with increase sensitivity to pain, prolonged pain duration, and predicts chronic pain. The degree of pain relief can directly impact the quality and disruption of sleep.
Methods: After approval from institutional review board, we reviewed YAC medical charts from March 2018 to April 2019 and extracted information pertaining to demographics, chronic pain and sleep. We present here the preliminary data of our multidisciplinary clinic
Results: 55 medical charts were reviewed which included 40 females, 13 males, 2 nonbinary individuals, with a mean age of 20.3±2.4 years. 53% of the patients had chronic widespread pain. Symptoms of or disorder of sleep were reported in 72.7% of the patients. The various nighttime disorders of sleep were trouble falling asleep, insomnia, problems with sleep initiation, difficulty in maintaining sleep, poor sleep continuity, frequent night awakenings due to pain, restless leg syndrome (RLS), obstructive sleep apnea, parasomnic behavior, circadian rhythm disorder such as delayed sleep phase disorder. As assessed by Epworth Sleepiness scale, 7% of the patients had mild, 7% had moderate and 2% had severe daytime sleepiness. 42% of the youths demonstrated a low self-efficacy score as per Pain Self Efficacy Questionnaire (PSEQ). Patient Health Questionnaire (PHQ-9) was used to measure the severity of depression which showed that 5.5%, 27%, 18%, 14.5%, 22% of the YAC patients suffered from minimal, mild, moderate, moderately-severe and severe depression respectively. The information collected on Pain Catastrophizing scale (PCS) suggested that 24%, 29% and 31% were at low, moderate, and high risk respectively in having catastrophizing thoughts and feelings related to pain. There was no statistical difference in the means PSEQ, PHQ-9 and PCS scores of young adults.
Conclusion: Sleep disturbances may be an important modifiable risk factor for alleviating distress in young adults with chronic pain.
Support (if any):

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INSUFFICIENT SLEEP LINKED WITH HIGHER COVID-19 INFECTION CASES AND DEATHS IN THE UNITED STATES

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Introduction: Causes of COVID-19 burden in urban, suburban, and rural counties are unclear, as early studies provide mixed results implicating high prevalence of pre-existing health risks and chronic diseases. However, poor sleep health that has been linked to infection-based pandemics may provide additional insight for place-based burden. To address this gap, we investigated the relationship between habitual insufficient sleep (sleep <7 hrs./24 hr. period) and COVID-19 cases and deaths across urban, suburban, and rural counties in the US.
Methods: County-level variables were obtained from the 2014–2018 American community survey five-year estimates and the Center for Disease Control and Prevention. These included percent with insufficient sleep, percent uninsured, percent obese, and social vulnerability index. County level COVID-19 infection and death data through September 12, 2020 were obtained from USA Facts. Cumulative COVID-19 infections and deaths for urban (n=68), suburban (n=740), and rural (n=2331) counties were modeled using separate negative binomial mixed effects regression models with logarithmic link and random state-level intercepts. Zero-inflated models were considered for deaths among suburban and rural counties to account for excess zeros.
Results: Multivariate regression models indicated positive associations between cumulative COVID-19 infection rates and insufficient sleep in urban, suburban and rural counties. The incidence rate ratio (IRR) for urban counties was 1.03 (95% CI: 1.01 – 1.05), 1.04 (95% CI: 1.02 – 1.05) for suburban, and 1.02 (95% CI: 1.00 – 1.03) rural counties.. Similar positive associations were observed with county-level COVID-19 death rates, IRR = 1.11 (95% CI: 1.07 – 1.16) for urban counties, IRR = 1.04 (95% CI: 1.01 – 1.06) for suburban counties, and IRR = 1.03 (95% CI: 1.01 – 1.05) for rural counties. Level of urbanicity moderated the association between insufficient sleep and COVID deaths, but not for the association between insufficient sleep and COVID infection rates.
Conclusion: Insufficient sleep was associated with COVID-19 infection cases and mortality rates in urban, suburban and rural counties. Level of urbanicity only moderated the relationship between insufficient sleep and COVID death rates. Future studies should investigate individual-level analysis to understand the role of sleep mitigating COVID-19 infection and death rates.
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CANNABINOIDS AND SLEEP HEALTH IN PATIENTS WITH CHRONIC NEUROPATHIC PAIN: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Neuropathic pain (NP) syndromes are debilitating conditions which can impact sleep health and overall quality of life significantly. Pharmacological treatment with cannabinoids has not been evaluated for its impact on sleep health. The objectives of this systematic review and meta-analysis were to determine the effect of cannabinoids on sleep quality, pain control, and patient impression of treatment efficacy.
Methods: We reviewed randomized controlled trials comparing synthetic and natural cannabinoids (CB) to placebo in patients with central and peripheral neuropathic pain syndromes. A systematic search of the standard literature databases was conducted, including randomized controlled trials evaluating the pharmacological treatment of NP syndromes using cannabinoids. Data on NRS pain scales, sleep quality, daytime somnolence, nausea, dizziness, and patient global impression of change (PGIC) scores were recorded. Meta-analysis using the random effects model was conducted where appropriate.
Results: Of the 3536 studies screened, a total of 8 randomized controlled trials including 1051 patients (placebo: 478 patients; CB: 573 patients) with neuropathic pain were included. Cannabinoids included in the studies were Sativex (GW-1000–02), Nabilone, and medical cannabis preparations with THC dose ranging from 1mg to 130mg per day. Pain scores were significantly reduced in the CB group (standardized difference in means (SDM) = -0.236, 95% CI=-0.375 to -0.100, p-value = 0.001) compared to placebo (Figure 1). Significant improvement in sleep quality (Figure 2) was also observed in the CB group (SMD 0.389, 95% CI, 0.233 to 0.546, p<0.013). Additionally, patients in the CB group were more likely to report improvement in PGIC scores (OR=2.3, 95% CI 1.37 to 3.9, p=0.002) compared to patients treated with placebo (Figure 3). Notably, CB-treated patients were more likely to experience daytime somnolence (OR=2.2, 95% CI 1.3 to 3.9, p=0.004), nausea (OR=1.7, 95% CI 1.1 to 2.5, p=0.02), and dizziness (OR=3.8, 95% CI 2.6 to 5.7, p<0.001).
Conclusion: Cannabinoids are useful agents for NP as evidenced by significant improvement in pain, sleep quality, and PGIC. With the advent of new agents and more refined cannabis derivatives, further research is needed to comprehensively explore treatment effectiveness. Future work should incorporate clinically validated measures of sleep health to better evaluate this outcome.
Support (if any):

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QUALITY OF SLEEP IS THE ONLY PREDICTOR OF SUICIDE DURING COVID-19 LOCKDOWN IN UNIVERSITY STUDENTS?

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Introduction: COVID-19 epidemic led to great psychological and social stress, related to anxiety, depression, sleep disorders, suicidal risk and behavior, and changes in daily routine. The aim of this study was to assess the psychological impact of COVID-19 lockdown in Italian students. We focused on perceived sleep quality, anxiety and depression symptoms, and mostly on risk of suicide.
Methods: A total of 307 students (mean age 22.84±2.68) completed Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), Beck Anxiety Inventory (BAI), and Beck Depression Inventory-II (BDI-II). In our study, we focused on item 9 of BDI-II, that is related to suicide. We divided our sample on presence or absence of suicidal ideation based on this item.
Results: We found that 30.1% showed depressive, while 38.2% anxious symptoms. Concerning item 9 of BDI-II (suicidal thoughts or wishes), 84.7% answered that they do not have any thoughts of killing themselves, while 15.3% answered that they have some suicidal ideation. Concerning sleep variables, we found that 58% of our sample showed a PSQI total score higher than 5 (poor quality of sleep), and a global worsening in sleep quality and increase of insomnia both in student with and without suicidal ideation.
Conclusion: Our results on risk of suicide are in line with literature. Recent reviews focused on suicidal ideation in medical students found that depressive symptoms and suicidal ideation are common among medical students, finding a prevalence of suicidal ideation of 11%. Several studies suggest that sleep disorders are a risk factor for suicidal thoughts and behaviours. Our findings show that sleep cannot considered a predictive factor of risk of suicide during health emergency, because the risk is polyfactorial.
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SLEEP QUALITY AFTER COVID-19 INFECTION

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Introduction: COVID-19 has proven to be a novel virus with significant complications to an expanding number of body systems. Hallmark characteristics of COVID-19 include substantial inflammatory response which has been linked to sleep dysregulation in previous studies. We examined the change in sleep quality after acute COVID-19 infections requiring hospitalization.
Methods: We performed a retrospective, single-center observational study of 20 patients with acute COVID-19 infection requiring hospitalization. Eligible patients were contacted and completed telephone surveys of the Pittsburgh Sleep Quality Index (PSQI) prior to and 1 month after hospital discharge. A score of ≥5 was indicative of poor sleep quality. Secondary data were collected from EMR.
Results: The mean PSQI prior to COVID-19 infection was 6.1, worsening to 10.3 one month after acute infection, denoting a delta-PSQI of 4.2 (p = 0.0004). There were noted statistically significant differences in certain components of the PSQI including: subjective sleep quality 0.8 to 1.7 (delta 0.9, p = 0.0003), sleep latency 1.25 to 1.85 (delta 0.6, p = 0.03), sleep disturbance 1.05 to 1.5 (delta 0.45, p = 0.0009), and daytime dysfunction 0.3 to 1.45 (delta 1.15, p = 0.0005). Sleep latency and daytime dysfunction accounted for the most change. Two groups declared themselves with 6 of the 20 patients having improvement/no change in PSQI, and 14 having worsening. Between these groups certain differences were seen including: Pre-infection PSQI 9.67 vs 4.57 (p = 0.009), delta global PSQI -0.83 vs 6.36 (p < 0.001), delta subjective sleep quality 0.17 vs 1.2 (p = 0.002), delta sleep latency -0.3 vs 1 (p = 0.01), delta sleep duration -0.3 vs 0.93 (p = 0.02), delta sleep efficiency -0.3 vs 0.71 (p = 0.02), and delta daytime dysfunction 0.17 vs 1.57 (p = 0.006).
Conclusion: In our study of patients hospitalized for COVID-19 infection specific components of sleep were different following infection. Sleep latency and daytime dysfunction contributed the most to PSQI change. Two groups declared themselves based on PSQI improvement

vs worsening. Those with poor sleep prior to infection continued to have poor sleep, while those without prior sleep troubles developed worsened sleep quality.
Support (if any):

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SLEEP QUALITY, DEPRESSION AND ANXIETY IN A COMMUNITY SAMPLE OF HABANA, CUBA DURING THE 2020 COVID-19 PANDEMIC

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Introduction: The 2020 Coronavirus disease 19 (COVID-19) pandemic has infected and killed millions of persons. To avoid virus spread, stay-at-home orders and social distancing measures were implemented worldwide. These measures have caused changes in work schedules and, subsequently, sleep habits. This study aims to examine sleep disturbances, anxiety and depression in a random community in Havana, Cuba during the pandemic lockdown period.
Methods: This a descriptive cross-sectional study performed in a randomly selected neighbourhood, via direct door-to-door survey. We applied four different surveys:1) Pittsburgh Sleep Quality Index (PSQI);2) Insomnia Severity Index (ISI);3) Epworth Sleepiness Scale (ESS) and 4) Hospital Anxiety and Depression Scales (HADS) questionnaire. Descriptive statistics will be applied using StatSoft, Inc. (2011) STATISTICA (data analysis software system), version 10. HYPERLINK "http://www.statsoft.com" www.statsoft.com
Results: A total of 366 adult subjects were surveyed and abnormal values were observed in the following percentages: 60.65% in the PSQI, 34.51% in the ISI, 14.74% in the ESS and 36.61% in the HADS for depression and 40.43% in the HADS for anxiety. Poorer sleepers and depression were more common women and elderly ($p<0.05$ for all comparisons). Anxiety and insomnia were seen mostly in subjects with higher education and working during this period ($p<0.05$ for all comparisons). Poor sleep correlated with insomnia, depression and anxiety ($p < 0.001$ for all comparisons).
Conclusion: There were sleep quality disruption in large percentage of subjects during the COVID-19 pandemic lockdown. Poor sleep and depression were worse in women and the elderly. Insomnia and anxiety were seen more in younger subjects that continue to work during this time.
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SLEEP HEALTH TRAITS AND COVID-19: MORTALITY RISK FROM THE UK BIOBANK

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Introduction: While there is emerging evidence for acute sleep disruption in the aftermath of coronavirus disease 2019 (COVID-19), it is unknown whether sleep traits contribute to mortality risk. In this study, we tested whether earlier-life sleep duration, chronotype, insomnia, napping or sleep apnea were associated with increased 30-day COVID-19 mortality.
Methods: We included 34,711 participants from the UK Biobank, who presented for COVID-19 testing between March and October 2020 (mean age at diagnosis: 69.4±8.3; range 50.2–84.6). Self-reported sleep duration (less than 6h/6-9h/more than 9h), chronotype ("morning"/"intermediate"/"evening"), daytime dozing (often/rarely), insomnia (often/rarely), napping (often/rarely) and presence of sleep apnea (ICD-10 or self-report) were obtained between 2006 and 2010. Multivariate logistic regression models were used to adjust for age, sex, education, socioeconomic status, and relevant risk factors (BMI, hypertension, diabetes, respiratory diseases, smoking, and alcohol).
Results: The mean time between sleep measures and COVID-19 testing was 11.6±0.9 years. Overall, 5,066 (14.6%) were positive. In those who were positive, 355 (7.0%) died within 30 days (median = 8) after diagnosis. Long sleepers (>9h vs. 6-9h) [20/103 (19.4%) vs. 300/4,573 (6.6%); OR 2.09, 95% 1.19–3.64, p=0.009), often daytime dozers (OR 1.68, 95% 1.04–2.72, p=0.03), and nappers (OR 1.52, 95% 1.04–2.23, p=0.03) were at greater odds of mortality. Prior diagnosis of sleep apnea also saw a two-fold increased odds (OR 2.07, 95% CI: 1.25–3.44 p=0.005). No associations were seen for short sleepers, chronotype or insomnia with COVID-19 mortality.
Conclusion: Data across all current waves of infection show that prior sleep traits/disturbances, in particular long sleep duration, daytime dozing, napping and sleep apnea, are associated with increased 30-day mortality after COVID-19, independent of health-related risk factors. While sleep health traits may reflect unmeasured poor health, further work is warranted to examine the exact underlying mechanisms, and to test whether sleep health optimization offers resilience to severe illness from COVID-19.
Support (if any): NIH [T32GM007592 and R03AG067985 to L.G. RF1AG059867, RF1AG064312, to K.H.], the BrightFocus Foundation A2020886S to P.L. and the Foundation of Anesthesia Education and Research MRTG-02-15-2020 to L.G.

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YOUNG AFRICAN AMERICAN ADULTS ENDORSE GREATER DISTRESS FROM RACISM THAN COVID THOUGH COVID MAY HAVE GREATER IMPACT ON SLEEP.

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Introduction: Much attention has been given to stress-related symptoms including insomnia related to the COVID-19 pandemic. Exposure to racially targeted police violence and the disproportionate impact of COVID on their communities have been particularly salient stressors for African Americans. Aims for this presentation are to illuminate the emotional impact of COVID and racism on young adult African Americans and their relationship to sleep problems.
Methods: An online survey was sent to participants in an ongoing study focusing on sleep and health along with new participants recruited through a snowball method. The survey included the Insomnia Severity Index (ISI), Impact of Event scale (IES), as well as items to assess experiences with COVID, exposure to racially targeted violence, and disparate community impact.
Results: Respondents were African Americans age 18–35. 45% endorsed worsening sleep during the pandemic. 25% had ISI scores of probable insomnia and 61% had IES scores above the symptom threshold for clinical concern. Racism-related distress was endorsed at higher levels than worries related to COVID. There was a significant relationship of insomnia severity with the number of COVID related stressors and a trend level relationship with COVID worries. Sleep outcomes were not correlated with racism-related distress.
Conclusion: While distress related to racism was endorsed more than COVID worries, our preliminary findings suggest COVID worries but not racism exposure negatively impact sleep health. This may be a

consequence of habituation to the chronic stress of racism in contrast with the novel stress of COVID.
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DAILY ASSOCIATIONS BETWEEN ADOLESCENT SLEEP AND MENTAL HEALTH DURING THE COVID-19 PANDEMIC

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Introduction: Sleep disturbances after a trauma forecast mental health difficulties such as post-traumatic stress symptoms (PTSS). COVID-19 has resulted in numerous stressors for youth (e.g., school closures, social isolation) that directly disrupt sleep and may have negative mental health consequences. However, investigations of sleep and adverse events in youth have primarily been limited to months or years after a trauma has occurred. How adolescent sleep patterns and mental health intersect during an ongoing adverse experience is unknown.
Methods: Adolescents from the United States (N = 503; 80.9% female; 13–18 years) participated in an online daily diary study within 3 weeks after COVID-19 was declared a national emergency. Participants completed one week of twice daily reports (5406 observations) on their nightly sleep (sleep timing, sleep quality, sleep onset difficulties, and nightmares) and daytime mental health symptoms (COVID-19 PTSS, positive affect, negative affect, and loneliness).
Results: Mixed models adjusting for age, sex, and socioeconomic status indicated that cyclical, bidirectional effects emerged, with daytime mental health symptoms predicting same-night sleep disturbances, and sleep disturbances predicting next-day mental health. Greater PTSS predicted sleep onset difficulties (Estimate = .02, SE = .004, t = 5.56 $p < .001$) and sleep onset difficulties predicted next-day PTSS (Estimate = .35, SE = .17, t = 2.04, $p < .05$). Greater daytime negative affect predicted greater nightmares (Estimate = .07, SE = .01, t = 4.97, $p < .001$), and nightmares predicted marginally more next-day negative affect (Estimate = .07, SE = .04, t = 1.66, p = .09). PTSS (Estimate = .01, SE = .003, t = 3.47, $p < .001$) and negative affect (Estimate = .05, SE = .03, t = 2.06, $p < .05$) both predicted poorer sleep quality the following night.
Conclusion: Findings suggest that mental health symptoms during the onset of the COVID-19 pandemic are associated with increased sleep disturbances. In turn, these sleep disturbances predict increased mental health symptoms. Overall, results provide a greater understanding of youth sleep patterns during COVID-19 and how sleep disturbances may inhibit resilience in the context of an ongoing stressor.
Support (if any): Center for American Indian and Rural Health Equity

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PATIENT CHARACTERISTICS & POSITIVE AIRWAY PRESSURE THERAPY COMPLIANCE DURING NYC'S 2020 COVID-19 PANDEMIC STAY-AT-HOME ORDERS

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Introduction: During the first surge of the COVID-19 pandemic in New York City, as New Yorkers were enjoined by authorities to stay-at-home, patient encounters were transitioned from office visits to telemedicine consultations. It was thought that increased stress during the pandemic would worsen rates of insomnia, and concerns regarding use of positive airway pressure (PAP) therapy during a respiratory pandemic would affect compliance. We sought to describe telemedicine success rates, the distribution of sleep problems evaluated remotely by telemedicine, and PAP compliance in our patient population.
Methods: Telemedicine encounters from March 16th through May 31st, 2020, were reviewed for show-rates, patient characteristics and clinician impressions, and were compared to administrative data from the 2.5 months prior to the stay-at-home period (the "control period"). PAP compliance was analyzed for forty randomly selected patients established on PAP therapy between January 1st and October 1st, 2019, and whose machines transmitted data to a digital management system between October 1st and December 31st, 2019. Compliance reports and AHI were compared between the stay-at-home- and control-periods for this randomly selected group of patients.
Results: The telemedicine show rate was 89.37% (compared to a 91.91% in-office show-rate during the control period); all these encounters were successfully completed. Sleep apnea was the predominant diagnosis during the stay-at-home period (44.33% of encounters), followed by insomnia (23.16%). Insomnia complaints were significantly higher during the stay-at-home period compared to the control period (23.16% versus 14.6% of encounters; $p < .05$), and among new- versus follow-up- patients (41.76% versus 35.99%). PAP compliance and AHI, however, were not statistically different for forty randomly selected patients between the control and stay-at-home periods.
Conclusion: Most stay-at-home period telemedicine encounters were successful. Sleep apnea, then insomnia, were common findings among new and follow-up patients during the stay-at-home period, and insomnia rates increased during the pandemic. PAP compliance and AHI were similar in a random cohort when compared between the stay-at-home and control periods.
Support (if any):

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FROM IN-LAB TO AT-HOME: MEASURING SLEEP AND MEMORY IN THE TIME OF SARS-COVID-19

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Introduction: The SARS-COVID-19 pandemic restricted in-lab research activities especially in older individuals who are considered at-risk for severe disease. To continue longitudinal sleep research in this population we sought to test the feasibility of remotely conducting at-home sleep and memory research and to compare two ambulatory polysomnography (PSG) devices for ongoing home sleep testing.
Methods: 20 older (age=65.6±5.5 years) cognitively normal adults (65% female) who had previously undergone 2 nights in-lab sleep, memory and vigilance testing were delivered equipment for 2 nights at-home, technician-guided remote PSG set-up (1 night each for Somté [EEG: Fp1-M2, Cz-M1] and Sleep Profiler (SP) [EEG: Fp1-Fp2] devices- randomized presentation), and 6 timed trials on a 3D spatial maze navigation memory plus morning psychomotor vigilance testing (PVT). The night-to-night differences for devices and in-lab versus at-home testing environments were compared for sleep macro and EEG microarchitecture using paired Wilcoxon rank sum and t-tests where appropriate. First-night maze completion time (CT) and PVT reaction time and lapses were also compared.
Results: 19 people completed 2 nights at-home PSG, 18 completed PVT and 9 completed all 6 maze trials. Quality frontal EEG signals were obtained for 16 SP and 11 Somté recordings. There was no

significant night to night differences (night 1–night 2) between in-lab and at-home environments for total sleep time (mean difference: in-lab= -0.27 vs at-home = 0.35 hours), wake after sleep onset (WASO) (median difference: in-lab= 3.0 vs at-home = 0.7 %WASO), or slow wave sleep (SWS) (mean difference: in-lab= -0.70 vs at-home = 2.3 %SWS). Relative frontal slow wave activity and spindle density were not significantly different between devices or environments. K-complex density (SP= 1.0 vs Somté =2.7/minNREM2, p=0.004) was significantly reduced with the SP device compared to Somté devices. There were no significant differences for maze CT and PVT measures between in-lab and at-home environments.

Conclusion: The night-to-night differences in sleep macroarchitecture do not appear to be influenced by environment or device however measures of EEG microstructure such as K-complexes, which are amplitude-dependent, may be underestimated with the Sleep Profiler device due to smaller EEG amplitude from a derivation with short inter-electrode distances.

Support (if any): NIH (R01AG056031, R01AG056531, K24)

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THE ASSOCIATION OF SLEEP DISORDERS IN PATIENTS WITH CHRONIC PAIN DISORDERS

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Introduction: Sleep and pain are interrelated and have a bidirectional relationship. The study was performed to identify the impact of sleep disorders on pain perception.

Methods: The institutional review board approved the study. Patients evaluated in the Pain Clinic between 1/1/2014 and 12/31/2017 who had polysomnography done were identified by database search. Chart review identified demographics, initial pain score, pain treatments, sleep disorder diagnosis, treatments of sleep disorder and pain scores after sleep treatments. Numerical pain score (NPS) and insomnia severity index (ISI) were used as a measure of pain and sleep quality, respectively. The descriptive statistics were presented by percentages, mean and standard deviations. Regression analysis was performed between initial NPS and ISI. T-test compared change in NPS for compliant and non-compliant subjects, before and after sleep treatments. Linear regression model identified factors associated with changes in pain perception after sleep treatments.

Results: Of the 320 participants identified, complete data was available for 180 subjects. The average age was 55.9±13.9; 51.41% were female; 60.2% were Caucasian and 26.64% were Hispanic. Initial NPS was 8.8±1.7, average ISI was 15.00±6.41, average BMI was 35.4±10.2. Ninety-five percent had a diagnosis of obstructive sleep apnea (OSA), 27.81% had restless leg syndrome, and 7.19% had complex sleep apnea. Since most patients had OSA, details of positive airway pressure (PAP) treatments were also investigated. Of 84% of subjects treated with PAP, compliance data were available for 53%, which showed 69% (n=55) being complaint with PAP. Initial NPS correlated positively with ISI (R2: 0.064±0.024, p<0.01). No difference in NPS was found in groups based on compliance, before and after PAP treatments. Regression model identified that BMI was the most significant factor in the change in NPS following sleep treatment (R2: 0.083±0.034, p = 0.03).

Conclusion: The study identified that the severity of pain is associated with poor quality of sleep. While this study failed to identify improvement in pain perception after successful OSA treatment, limited number of subjects in our study were compliant with PAP treatment which may have impacted the results. Future prospective studies are needed to understand the complex association between improvement in sleep quality and pain perception.

Support (if any):

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PAP USE PATTERN CHANGE DURING THE COVID-19 LOCKDOWN

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Introduction: The COVID-19 pandemic has greatly impacted not only the physical health of society, but also its social, mental, and economic health. The Illinois shelter in place orders enacted in March and April limited work and activities outside the home. Our aim for this study was to compare the effects of the COVID-19 shelter in place orders on PAP use patterns in patients with OSA.

Methods: We selected 30 patients seen between May and October 2020. Patients had been diagnosed with OSA for at least one year, prescribed PAP therapy and had been compliant with therapy as defined by 70% use greater 4-hour for 30 days prior to their clinic visit. Using data collected from chart review as well as online ResMed AirView cloud data, we evaluated PAP on/off and average use time during shelter in place order for a 90 day period (March through May 2020). We compared this data to a similar period in the year prior.

Results: Average age of our study group was 58.6 years old with 19 men and 11 women. Mean AHI was 51.7. Reported average bedtime was 10:00pm with average wake time 7:30am during the shutdown compared with a bedtime of 9pm and wake up time 6:30am. Patients reported having more time to sleep and required less naps during the day. Average PAP use during shut down was 7 hours 20 minutes and average PAP use prior to shutdown was 6 hours and 50 minutes. An average of 30 additional PAP minutes was observed among patients during the shelter in place order. Only one of our patients was diagnosed with COVID during this time period.

Conclusion: For patients with OSA on PAP therapy we observed an increase in PAP use. Among patients suddenly required to shelter in place, we observed a delayed sleep onset and wake time of more than 1 hour, resulting in a slightly longer overall PAP use time. This circadian phase shift was greater among working patients compared to retired patients. The health effects of longer PAP use and circadian phase shifting remain to be determined.

Support (if any):

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SLEEP AND MENTAL HEALTH IN COLLEGE STUDENTS BEFORE AND DURING THE INITIAL COVID-19 SHUTDOWN

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Introduction: The COVID-19 pandemic has had an unparalleled impact on college students. Following the initial and abrupt shutdown of campuses in March 2020, several investigators assessed the immediate effects on University students. Early reports found that college students reported a higher prevalence of anxiety and depression, sedentary behavior, and sleep problems. Most were conducted outside the U.S. Data from U.S. college students are critical to identify which areas are should receive resources and interventions as the U.S. continues to experience exponential COVID cases along with continued remote learning, social restrictions and/or lockdowns.

Methods: Students enrolled in the Spring 2020 semester (18 years of age +) were invited to participate in an online survey (April – May

2020). A final sample of 491 completed the entire survey (length ~45 minutes) which asked about sleep quality, psychological stress, depression, and exercise.Paired t-tests were conducted to compare pre-COVID and during COVID data.
Results: There were significant differences in sleep onset latency (26.44 ± 23.53 min vs 32.06 ± 26.88 min; t = -3.81, P < .001), sleep duration (7.30 ± 1.45 hours vs 7.63 ± 2.07 hours; t = -2.23, p = 0.027) and overall sleep quality (6.29 ± 3.29 vs 7.44 ± 3.86; t = -7.26, p < .001), as well as depression scores (IDS no sleep questions) (5.61 ± 4.18 vs 17.59 ± 5.45; t = -54.9, P < .001). There was no difference in perceived stress (28.03 ±5.27 vs 28.39 ±5.53, t = -1.49, p = .138). Exercise (vigorous, moderate and walking) all decreased with regards to days and time spent, (all P's < .001), whereas minutes sitting significantly increased (426.50 ± 239.88 vs 542.26 ± 249.63, p < .001).
Conclusion: These data empirically support the claim that the pandemic is having a significant negative impact on physical and mental health among college students. In the best of times, college students have irregular sleep patterns and significant depression, but these behaviors are worsened under government restrictions. These findings underscore the need to prioritize prevention and intervention of modifiable behaviors, especially if the pandemic extends into 2021.
Support (if any):

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ASSOCIATION OF SELF-REPORTED ANXIETY, INFORMATIONAL SUPPORT, AND SLEEP IN SLEEP MEDICINE PATIENTS DURING THE COVID-19 PANDEMIC

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Introduction: Stressful events, such as the COVID-19 pandemic, can have a detrimental effect on sleep. It is important for practitioners to understand how their patients are affected by events to optimize their care. In this study we evaluated associations of anxiety and daily habits with self-reported sleep disturbance among sleep medicine clinic patients.
Methods: Between June-November 2020, 81 sleep medicine clinic patients (54.8±15.9 y, 44% male, 69% Caucasian) completed an online survey that included PROMIS measures (Sleep Disturbance, Sleep-Related Impairments, Informational Support, Emotional Distress-Anxiety) and Insomnia Severity Index (ISI). Patients were asked about changes in their daily habits (sunlight exposure, caffeine consumption). During the 5-month survey completion time window, the weekly average of positive COVID-19 cases in the Houston area was 2,914. Stepwise linear regression was performed using SAS to determine if self-reported anxiety and informational support predicted PROMIS Sleep Disturbance, PROMIS Sleep-Related Impairments and ISI.
Results: Anxiety had a significant effect on Sleep Disturbance (0.43 ± 0.11, p=0.0001), Sleep-Related Impairments (0.53 ± 0.12, p=0.0001) and ISI (0.28 ± 0.08, p=0.0004). Informational support had a significant inverse effect on Sleep Disturbance (-0.29 ± 0.10, p=0.0063), Sleep-Related Impairments (-0.26 ± 0.11, p=0.01) and ISI (-0.31 ± 0.08, p<0.0001) measures. Decreased sunlight exposure during the pandemic contributed to a significant increase in Sleep Disturbance scores (0.06 ± 0.03, p=0.045). Increased caffeine consumption during the pandemic had significant increase in ISI scores (16.3 ± 7.59, p=0.035).
Conclusion: Higher levels of anxiety and lower levels of informational support predicted greater insomnia severity, sleep disturbance, and sleep-related impairments in sleep medicine clinic patients during the COVID-19 pandemic. Decreased sunlight exposure and increased caffeine consumption also predicted greater sleep disturbance and insomnia severity, respectively. Addressing anxiety symptoms and access to accurate information during the pandemic is advised when treating sleep medicine clinic patients.
Support (if any): This work is supported by National Institutes of Health (NIH) Grant # R01NR018342 (PI: Nowakowski) and by the Department of Veteran Affairs, Veterans Health Administration, Office of Research and Development, and the Center for Innovations in Quality, Effectiveness and Safety (CIN 13–413).

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RAPID ADOPTION OF TELEMEDICINE DURING COVID-19 PANDEMIC: IMPACT ON PAP ADHERENCE AND HEALTH CARE UTILIZATION

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Introduction: The COVID-19 pandemic has required rapid reconfiguration of healthcare services from in-person to telemedicine. Positive Airway Pressure (PAP) is the gold-standard treatment for sleep apnea, but success requires substantial clinical support, which has traditionally been provided in-person. In this quality analysis, we examined the impact of PAP initiation (PAPI) via telemedicine on adherence and subsequent health care utilization, compared to the conventional, in-person model.
Methods: Patients who completed PAPI and initial adherence period between April-August 2020 were included. During this window, telemedicine visits were encouraged, but not required. Adequate adherence status was considered met if 21/30 consecutive days with use >4h was achieved by day 90 therapy. Health care utilization was represented by the number of follow-up visits, stratified by provider type (Physician, Physician Assistant (PA), or PAP Technologist).
Results: 839 patients (54% telemedicine, 46% in-person), 38.0% female, aged 54.2±0.5 years, BMI 32.4±0.3 (±SEM) were included. Adherence was similarly achieved following both initiation methods: 78.8% (telemedicine) and 76.4% (in-person) (p>0.4). Clinical follow-up was lower after in-person PAPI compared to telemedicine, regardless of adherence status (p<0.05). Non-adherent patients also had less clinical follow-up than adherent patients after both initiation methods (p<0.0001), though this differed by provider type. Non-adherent patients in both initiation methods were less likely to follow-up with a PA or PAP Technologist (p<0.01), though follow-up rate with Physician providers was similar (p>0.1). Clinical follow-up with PAP Technologist was increased after telemedicine compared to in-person PAPI (p<0.01).
Conclusion: Implementation of a telemedicine PAP initiation protocol during the COVID-19 pandemic resulted in similar rates of adherence compared to the conventional in-person method, which suggests that telemedicine is an appropriate alternative to in-person PAPI. However, clinical follow-up was lower after in-person PAPI compared to telemedicine regardless of adherence status. Further, non-adherent patients had less follow-up with PAs and PAP Technologists, but similar follow-up with Physicians. This may indicate that provider type plays a role in supporting patients through the adherence process and should be considered. Further research is needed to understand the relationship between care teams, adherence, and healthcare utilization in the age of telemedicine.
Support (if any):

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HEALTHY SLEEP AS AN IMPORTANT RESOURCE AND BUFFER FOR INTERSECTIONAL DISCRIMINATION: RESULTS FROM COVID 19 STUDY

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Introduction: Our previous studies have highlighted sleep disparities for this underserved population, including how Grandparents Raising Grandchildren (GRG) experience troubled and disruptive sleep. Intersectional types of discrimination facing these families during COVID 19, include: race/ethnicity of self and children, income, age, essential workforce status, and impairments (mobility, vision, and hearing). This current study intends to explore how healthy sleep is an important resource (potential buffer) for GRG experiencing intersectional discrimination during COVID 19.
Methods: We used community partnerships to recruit 600 GRG from all fifty states in USA and several tribes to complete an online survey on their experiences with caregiving and intersectional discrimination during COVID 19. We developed an index on intersectional discrimination based on GRG lived experiences to inform the survey and used descriptive and bivariate statistics to profile this group. Chi-square Automatic Interaction Detector (CHAID) analysis was used to build a predictive model to help determine how variables in our study best merge to explain intersectional discrimination.
Results: Of the GRGs', 37% were between 54–65 years and 33% cared for children 6 to 10 years for at least 5 years. The types of discrimination that were more likely to be included in intersectional discrimination include: Black or African American [83.8% (31)], my child's race [59.5% (22)], my lower economic status [56.8% (21)], and my status as a caregiver [56.8% (21)]. The resource needs that showed the most disparity (higher rate showed higher priority/extreme concern) between those with ID and those without included: Information on how COVID impacts race and ethnicity differently (6.0 vs. 3.61), ability to pay utilities (3.7 vs. 1.99), and information on how to achieve healthy sleep (4.19 vs. 2.64).
Conclusion: This study suggests that GRG facing intersectional discrimination identify the importance of attaining information on how to achieve healthy sleep as an important resource to them during COVID 19. These results can be used to help mobilize resources and disseminate information for this underserved group to improve healthy sleep and also model for their extended families and communities.
Support (if any): This study was conducted by the Grandfamilies Outcome Workgroup, (GrOW), with support from Generations United and Collaborative Solutions.

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ASSOCIATION OF SOCIAL ISOLATION, PERCEIVED STRESS, AND CPAP USE IN SLEEP MEDICINE PATIENTS DURING THE COVID-19 PANDEMIC

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Introduction: Due to the COVID-19 pandemic, many individuals are likely experiencing increased stress and social isolation. This study aimed to examine the effect of perceived stress and social isolation on self-reported continuous positive airway pressure (CPAP) use and treatment adherence among sleep medicine clinic patients during the pandemic.
Methods: Between June-November 2020, 81 sleep medicine clinic patients (54.8±15.9y, 44% male, 69% Caucasian) completed an online survey that included self-reported changes in CPAP use and using CPAP as advised; and PROMIS Social Isolation and Perceived Stress Scale (PSS). CPAP measures were categorized based on reported changes during the pandemic. Stepwise logistic regression was performed using SAS to determine if Social Isolation and PSS predicted change in CPAP measures.
Results: Among participants, 53% reported using CPAP. Out of those, 61% reported change, 16% reported no change, and 23% reported they do not know if there is a change in using CPAP as advised during the pandemic. Social Isolation predicted an increase in odds of CPAP use by a factor of 1.15 (p=0.024). PSS predicted a decrease in odds of using CPAP therapy as advised by a factor of 0.86 (p=0.049).
Conclusion: Increases in perceived stress predicted lower odds of utilizing CPAP as advised. Increases in self-reported social isolation predicted greater odds of CPAP use in sleep medicine clinic patients during the COVID-19 pandemic. Addressing stressors/coping and social isolation/support as part of routine clinical care in sleep medicine clinic patients is advised.
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CHANGES IN HEALTHCARE VISITS AND SLEEP MEDICATION USE IN SLEEP MEDICINE PATIENTS DURING THE COVID-19 PANDEMIC

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Introduction: Patients may be experiencing increased stress and sleep disturbance due to healthcare changes during the COVID-19 pandemic. Healthcare changes may include telemedicine visits, delayed or canceled appointments and sleep studies. The purpose of this study was to assess the association between changes in healthcare and sleep medication use on sleep disturbance and insomnia severity.
Methods: Between June-November 2020, 81 sleep medicine clinic patients (54.8 ± 15.9 y, 44% male, 69% Caucasian) completed an online survey that included questions about COVID-19 (tested for coronavirus, test results, willingness to be vaccinated for COVID-19, changes in health care visits and sleep medications during the pandemic), PROMIS measures (Sleep Disturbance, Sleep-Related Impairments), and Insomnia Severity Index (ISI). Stepwise linear regression was performed using SAS to determine if changes in healthcare and sleep medications predicted poorer sleep.
Results: Among participants, 32% were tested for coronavirus, out of those 8% tested positive for COVID-19. 74% were willing to get vaccinated and 65% were willing to get their children vaccinated. 35% changed their healthcare office appointments to telephone visits, 54% changed to video visits; whereas 26% cancelled and 32% rescheduled their healthcare appointments. Changes in health care visits during the pandemic had a significant increase on ISI score (3.98 ± 1.66, p=0.019). Changes in sleep medication during the pandemic had significant effect on Sleep Disturbance (7.15 ± 2.51, p=0.005), Sleep-Related Impairments (8.69 ± 2.68, p=0.001) and ISI (6.04 ± 1.66, p=0.001) measures.
Conclusion: Sleep medicine patients who reported changes in sleep medication reported higher insomnia severity, sleep disturbance, and

sleep-related impairments. Patients who reported changes in healthcare visits during the pandemic reported higher insomnia severity. Assessing sleep medication changes and preference for healthcare visit format is advised when treating sleep medicine patients during the pandemic.
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COVID-19 RISK PERCEPTION, SLEEP HEALTH AND PERITRAUMATIC DISTRESS AMONG NEW YORKERS: THE NYU COVID-19 MENTAL HEALTH STUDY

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Introduction: Long-term exposure to pandemics like COVID-19 may increase psychological distress (e.g., peri-traumatic and post-traumatic distress) and sleep problems. Little is known about the effects of COVID-19 on peritraumatic distress, a well-documented risk factor for post-traumatic stress disorders (PTSD). The aim of this study was to investigate the association between COVID-19 risk perception and peritraumatic distress, and whether this relationship is moderated by sleep quality among individuals located in NY.
Methods: We examined data from 541 individuals (69% were female, mean age (SD) = 40.9 (15.3)] recruited online during summer and fall 2020 in New York for the NYU-COVID-19 Mental Health Study. Data were gathered on sociodemographic, COVID-19 risk perception (yes or no items), peri-traumatic distress measured by Peritraumatic Distress Inventory (PDI), and sleep quality measured by the Pittsburg Sleep Quality Index (PSQI). Descriptive, regression analysis and interaction terms were conducted using SPSS v. 25 to examine associations between COVID-19 risk perception with symptoms of peritraumatic distress and sleep quality.
Results: Of the 541 participants, 311(57.5%) reported they felt at risk for contracting COVID-19. PSQI was positively correlated with PDI (r =.38, p =0.01). An independent sample t student test indicated, on average, that the symptoms of PDI [(mean (SD)=27.3 (7.63), t = 7.07, n =307)] and PSQI [mean(SD)=10.62(3.57), t=4.31 n=311)] of our participants who felt at risk for contracting the COVID-19 significantly exceeded those who did not [(PDI mean(SD)=22.7(7.13), n =228); PSQI (mean(SD) =9.25(3.72), n=229]. Results of multiple linear regression analysis shown that COVID-19 risk perception was the strongest predictor of PDI [B(t) = −.630(12.7); p < .001]. Furthermore, the interaction effect of PSQI scores and COVID-19 risk perception revealed that sleep quality significantly reduced the association between COVID-19 risk perception and PDI [B(t) = .319(5.71); p <.001], such that poorer sleep and feeling at risk of contracting COVID-19 resulted in more severe PDI scores.
Conclusion: COVID-19 risk perception was associated with peritraumatic distress and poorer sleep quality, and sleep quality attenuated this relationship.
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SLEEP OF INFANTS AND TODDLERS DURING 12 MONTHS OF THE COVID-19 PANDEMIC

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Introduction: SARS-CoV-2 changed the lives of children and their parents in 2020. To our knowledge, no studies have examined infant and toddler sleep during this pandemic. We sought to compare parent-reported sleep characteristics of infants and toddlers over successive quarters of the past year.
Methods: Parents of children aged 0–36 months were surveyed primarily in the Midwestern USA between 01/17/2020 and 12/07/2020. Each parent responded only once. Age was categorized as: <6 months, 6–12 months, 12–24 months, and 24–36 months. Income was categorized as: <$50,000, $50-100,000, $100-150,000, and >$150,000. The year was divided into quarters. Multivariable linear regression included Total Sleep Time (TST), Sleep Onset Latency (SOL) and parental frustration with sleep (any frustration, scale of 1–5) as dependent variables and year quarter, child's age, prematurity, child's comorbidities, maternal age (during their child's birth), parenting experience, household income, and room sharing as independent variables. Logistic regression included nap consistency (napping at the same time daily) as the dependent variable, and year quarter, child's age, prematurity, comorbidity, maternal age, parenting experience, household income, and room sharing as independent variables.
Results: Of 594 children, mean age was 18.5±9.7 months and 52% were female. Prematurity and comorbidities were reported for 8% and 15%, respectively. Mean maternal age was 31.8±4.5 years. Neither TST (β=-0.488; p= 0.16) nor SOL (β= 0.029; p=0.23) were associated with year quarter. SOL was 3 minutes less for each increase in income category (β =-0.051; p= 0.003). TST (β = -0.994; p<0.001) and SOL (β =0.092; p<0.0001) were most associated with child's age. Parental frustration was associated with child's age (β=0.12; p= 0.04), comorbidity (β=0.30; p=0.05) and room sharing (β= -0.38; p=0.006), but not year quarter. Nap consistency was associated with increased child age category (OR 1.47; 95% CI 1.13, 1.94) and lack of room sharing (OR=2.09; 1.10, 3.97), but not year quarter.
Conclusion: Parent-estimated TST, nap consistency and sleep-related frustration did not differ significantly over the first 12 months of the pandemic. Yet, our results underscore that special attention should be given to the sleep of infants and toddlers with comorbidities, who share a room, and who have a lower household income.
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SLEEP DISORDERED BREATHING POLYSOMNOGRAPHIC MEASURES AND COVID-19 RISK OF WHO-7 CLINICAL OUTCOMES IN A LARGE HEALTH CARE SYSTEM

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Introduction: There is lack of clarity of sleep disordered breathing (SDB)--including the role of nocturnal hypoxia and confounding influence of obesity--on the clinical course of human coronavirus disease 2019 (COVID-19). We postulate that SDB portends increased risk of adverse COVID-19 clinical outcomes even after accounting for confounding factors.
Methods: A retrospective cohort analysis of COVID-19 and sleep laboratory observational registries March-November 2020 within the Cleveland Clinic health system was performed. Ordinal logistic

regression assessed the association of SDB indices and World Health Organization (WHO)-7 COVID-19 clinical outcome (hospitalization, use of supplemental oxygen, non-invasive ventilation, mechanical ventilation/ECMO and death) in an unadjusted model and adjusted for age, sex, race, body mass index(BMI,kg/m2),diabetes mellitus, hypertension, coronary artery disease, heart failure, asthma, chronic obstructive pulmonary disease (COPD), cancer and smoking using SAS software.

Results: Of 19,449 (32%) patients positive for SARS-CoV-2,2,290 (6%) had an available sleep study. The analytic sample included 1788 of which 1,484(64%) had an apnea hypopnea index (AHI, 3–4% hypopnea oxygen desaturation)≥5. The median duration from sleep study to COVID test was 5.8 years (IQR:3.3–9.0). Age was 56.5±14.4 years,50.4% female,28% African American with BMI=35.9±8.9kg/m2. Nine percent of patients were hospitalized,10% with supplemental oxygen,6% used non-invasive ventilation,2% required ECMO or mechanical ventilation and 2% died. For every AHI increase of 5, the odds of a higher WHO-7 level increased 2% (OR=1.02,95%CI1.01-1.04,p=0.005),but the association was mitigated in the adjusted model (OR=1.00,95%CI:0.98,1.02,p=0.80). Per 5% increase in time spent with SaO2<90%, the odds of a higher WHO-7 level increased 10% (OR=1.10,95%CI1.06-1.13,p=<0.001) persisting in the adjusted model(OR=1.06,95%CI:1.02–1.10,p=0.002). For every decrease of 5% mean SaO2, the odds of a higher level WHO-7 increased 56% (OR=0.56,95%CI:0.46–0.67,p<0.001) persisting in the adjusted model(OR=0.72,95%CI:0.58–0.89,p=0.003).

Conclusion: Even after adjustment for obesity, underlying cardiopulmonary disease and smoking, sleep-related hypoxemia was a potential key pathophysiologic mechanism associated with increased morbidity and mortality in COVID-19. Elucidation of sleep-related hypoxemia as a risk stratification measure, particularly given the silent hypoxia inherent to early COVID-19, is critical for future investigation, as is the role of sleep-related hypoxia reversal as a target to improve COVID-19 outcomes.

Support (if any): Cleveland Clinic Neurologic Institute Resource Development Award

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INSOMNIA AS A RISK FOR PTSD DURING THE COVID-19 PANDEMIC

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Introduction: The COVID-19 pandemic and associated attempts to curb its spread have led to a significant increase in mental health issues. Evidence suggests that sleep provides a protective resilience against the adverse effects of stress. Moreover, sleep disruption is often considered the "hallmark symptom" of posttraumatic stress disorder (PTSD). Here we hypothesized that insomnia would increase during the first six months of the pandemic, and that higher insomnia would be associated with elevated rates of PTSD.

Methods: A total of 6,190 adults ranging in age from 18 to 84 years (53.6% female), completed an online cross-sectional survey at one of six time points between April and September 2020 (~1,000 per administration). Instruments included the Insomnia Severity Index (ISI), Primary Care PTSD Checklist (PC-PTSD), and the PTSD Checklist-5 (PCL-5). Standard clinical cutoffs were used for ISI (≥10) and PCL-5 (≥38). Data were analyzed with analysis of variance, chi-square contingency tables, and bivariate correlations.

Results: Over the first six-months of the pandemic, PTSD increased with each passing month on both the PC-PTSD (p=.001) and PCL-5 (p<.0001). Similarly, ISI scores increased month-by-month (p<.0002). Insomnia scores were highly correlated with PCL-5 PTSD scores (r=.62, p<.0001), even when sleep items on the scale were excluded (r=.60, p<.0001). Finally, the rate of PTSD remained below 5% across all months for those without insomnia, but among those with insomnia, the prevalence of PTSD increased between May (26% positive) and September (40% positive), representing an increase of 56% over the data collection period (interaction p=.0004).

Conclusion: Both insomnia and PTSD have increased dramatically over the first six months of the COVID-19 pandemic. Moreover, insomnia appears to be highly linked with the emergence of PTSD during this time. While it is not possible to make causal attributions from these cross-sectional findings, the steadily increasing rates of PTSD over time only among those with insomnia, raise the possibility that sleep disruption could act as a diathesis for the development of PTSD symptoms in response to the pandemic. Addressing insomnia during the pandemic may be an important aspect of maintaining psychological resilience in the populace.

Support (if any):

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LONELINESS AND LOCKDOWNS: THE EFFECTS OF THE COVID-19 PANDEMIC ON INSOMNIA SYMPTOMS

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Introduction: Insomnia is a critical health issue that has serious consequences for both psychological and physical health. These consequences have become even more exacerbated during the course of the ongoing COVID-19 pandemic, as fears of the virus continue to grow and community lockdowns persist. Loneliness has also become a growing mental health concern as a result of the pandemic, and previous research has identified COVID-19 loneliness as a contributing factor to higher rates of insomnia. The current study aimed to investigate the relationship between insomnia, loneliness, and lockdown orders across the first 6-months of the pandemic. We hypothesized that being lonely and under lockdown would lead to greater insomnia, even after controlling for anxiety, and this would become more pronounced over the course of the pandemic.

Methods: 6,101 English-speaking adults from across the U.S. (18–84 years old; 53.6% female) completed an online, monthly, cross-sectional (~1000 participants per month), battery of assessments that included the Insomnia Severity Index (ISI), UCLA Loneliness Scale – Version 3, Generalized Anxiety Disorder-7 scale (GAD 7), demographic questions, and a COVID-19 questionnaire between April 2020 and September 2020. A 2 (lonely vs. not lonely) x 2 (lockdown vs. no lockdown) x 2 (Time 1 April-June vs. Time 2 July-September) ANCOVA was conducted to determine the effects of these variables on insomnia, while also controlling for anxiety symptoms.

Results: Significant main effects of lockdown status, $F(1,8) = 22.72$, $p < .001$, time, $F(1,8) = 4.94$, $p = .026$, and loneliness, $F(1,8) = 65.18$, $p < .001$, were observed, as a well as a significant interaction effect between lockdown status and time, $F(1,8) = 8.47$, $p = .004$, after controlling for anxiety.

Conclusion: Overall, lonely people under lockdown had the highest levels of insomnia at both Time 1 and Time 2. Non-lonely people consistently had lower levels of insomnia than lonely people across the 6-month period; however, being under lockdown also contributed to higher levels of insomnia regardless of loneliness, which increased with each passing month of the pandemic. Loneliness and lockdowns each appear to be independently associated with elevated insomnia during the COVID-19 pandemic.

Support (if any):

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SLEEPING WELL DURING A PANDEMIC: THE ROLE OF VARIOUS FORMS OF SOCIAL SUPPORT IN PROTECTING AGAINST INSOMNIA

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Introduction: Social support from friends, family, and significant loved ones is critical to sustaining mental health during crises. During the course of the COVID-19 pandemic, the populace has had to restrict many aspects of normal social contact. Consequently, social isolation and accompanying feelings of loneliness have spiked. There has also been a contemporaneous increase in the rates of insomnia. Considering this correlation, we investigated the potential role of various types of social/emotional support on the severity of insomnia. We hypothesized that greater social support from family, friends, and significant loved ones would all contribute to lower insomnia during the pandemic.
Methods: During October 2020, 1020 participants (58.2% female) completed an online survey that included the Multidimensional Scale of Perceived Social Support (MSPSS), a measure of social support, and the Insomnia Severity Index (ISI), a measure of insomnia. The severity of insomnia was predicted using multiple linear regression, with the three sources of support from the MSPSS (family, friend, and significant other) entered stepwise.
Results: All three sources of support were significantly correlated with lower ISI scores (family, r=-.163, p= p = 1.6x10-7; friend, r=-.125, p=6.5x10-5; significant other, r=-.095, p=.002). However, when all three variables were entered into stepwise regression, only increased familial support was significantly associated with lower insomnia levels (R2 = 0.027, β =-.163, p = 1.6x10-7). In contrast, neither the support of friends nor support from significant others added any additional predictive power once family support was in the model.
Conclusion: While perceived social support from friends and significant others was correlated with lower insomnia, we found that ISI scores were most significantly associated with perceived family support. In fact, once family support was accounted for, other sources of support did not account for additional variance. Ongoing family support plays a critical role in mental health and wellbeing, which is clearly demonstrated in the quality of sleep. During the social distancing imposed by the pandemic, it is vital that we find creative ways to maintain familial social support. Future work may benefit by examining the association between the use of electronic technologies to sustain social support and sleep outcomes.
Support (if any):

718

INVESTIGATING DECREASED POSITIVE AIRWAY PRESSURE COMPLIANCE IN A VETERAN AFFAIRS SLEEP MEDICINE CLINIC DURING THE 2020 PANDEMIC

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Introduction: Positive airway pressure (PAP) compliance for the treatment of sleep apnea at the Albuquerque Veterans Affairs (VA) Sleep Medicine clinic has been observed to be lower in new setup patients after the onset of the COVID-19 pandemic. The reasons for decreased PAP compliance during the COVID-19 pandemic are unclear. The primary outcome will be to identify if there is a common reason that patients at the Albuquerque VA were less compliant with PAP after the onset of the COVID-19 pandemic.
Methods: Compliance data for 4/1/2020 through 9/30/2020 was compared to compliance data for 4/1/2019 through 9/30/2019. Compliance after PAP machine setup was confirmed to be lower during the 2020 time period. Noncompliant patients will be selected by setup type, new versus machine replacement, and surveyed for reasons for noncompliance. The survey will be conducted at the Albuquerque VA Sleep Center and will include questions regarding beliefs, barriers, and challenges with the use of PAP therapy during the coronavirus pandemic. The definition for initial PAP compliance will be the use of PAP therapy for greater than or equal to four hours per night on at least 70% of nights.
Results: For the 6-month time period of 4/1/2019 through 9/30/2019, there were 758 PAP setups at the Albuquerque VA. The 30-day compliance for the 758 setups was found to be 61.4%. Comparatively, for the six-month period of 4/1/2020 through 9/30/2020, there were 462 setups with a 30-day compliance result of 49.7%. A survey consisting of questions designed to elicit barriers to use as well as beliefs regarding PAP and COVID-19 will be administered to 20% (n = 46) of the non-compliant patients who were set up with a PAP machine during the 2020 study period.
Conclusion: PAP compliance after machine setup was lower at the Albuquerque VA sleep center in 2020 versus 2019 (49.7% versus 61.4%). The reasons for the lower observed compliance are attributed to the effects of the coronavirus pandemic. A random sampling of the non-compliant patients during the 2020 time period will be performed and the results will be presented once available.
Support (if any): None

719

INSOMNIA IN THOSE DIAGNOSED WITH COVID-19

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Introduction: Recent meta-analyses suggest that as many as 75% of COVID-19 patients report sleep problems. Here, we sought to characterize this in terms of self-reported insomnia. We hypothesized that those endorsing a positive COVID-19 diagnosis would also report greater levels of insomnia than those with a negative diagnosis.
Methods: Between April and September 2020 we administered the Insomnia Severity Index (ISI), each month to a total of 6162 English speaking adults in the United States ranging in age from 18–84 (M=36.2 years, SD=12.1; 53.9% female), recruited from all 50 states and the District of Columbia using Amazon Mechanical Turk (MTurk) crowdsourcing platform. Data collections occurred cross-sectionally, approximately one month apart. Data were analyzed using Kruskal-Wallis H tests.
Results: In total, 247 (4.01%) participants responded "Yes" to the question "Have you been formally diagnosed with COVID-19?" (male=128, female=119). Those reporting "yes" had a higher mean score on the ISI (M=14.52, SD=5.56) compared to reporting "no" (M=9.98, SD=6.55). Total ISI scores were higher for those who reported that they were diagnosed with COVID-19 than those that did not, $\chi 2(1)=121.818$, p=0.0001. Among those that reported that they were diagnosed with COVID-19, 57.11% had ISI scores indicating moderate to severe clinical insomnia compared to 25.42% of those who were not diagnosed with COVID-19.
Conclusion: Those who reported that they had been diagnosed with COVID 19 had greater insomnia compared to those without such a diagnosis. This could be due to greater stress and anxiety in those who had a positive COVID-19 diagnosis due to the many uncertainties surrounding the short and long-term prognosis as well as potential impacts on the individual's family and workplace. However, it is important to consider the broader health picture of those diagnosed with

COVID-19. This study is limited by the nature of the self-reported data, where we cannot verify a positive COVID-19 test. Causality cannot be inferred due to the cross-sectional nature of this study. Future work will need to determine the extent to which sleep-related factors are due to biological versus psychological factors associated with the diagnosis of COVID-19.
Support (if any):

720

ACTIGRAPHY TO EVALUATE SLEEP IN THE INPATIENT SETTING: A SYSTEMATIC REVIEW

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Introduction: Sleep disruption is common among hospitalized patients due to psychological, physiological, and environmental reasons including illness, pain, anxiety, invasive interventions, frequent monitoring, and stimuli, especially noise and light. The AASM has published guidelines for the use of actigraphy in the outpatient setting, but there is a paucity of literature evaluating the validity of actigraphy in inpatients. We sought to summarize the evidence surrounding the use of actigraphy for inpatient sleep evaluation.
Methods: Systematic review was conducted according to the Preferred Reporting of Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Databases were queried by two independent reviewers for English-language studies published between 1990 and 2020. The initial search screened for all occurrences of "actigraphy AND sleep AND hospital" then was further refined to include studies of actigraphy used for monitoring in the inpatient hospital setting and exclude studies evaluating actigraphy in outpatient, rehabilitation, immediate postoperative, or intensive care unit settings.
Results: 1221 were screened from initial search results. 48 articles were identified through screening of abstracts. Full-text review of the articles was then completed. Of the 48 articles, a total of 12 studies examined general medical inpatients, 12 studies examined inpatients with neurologic disorders, 5 studies examined inpatients with cancer, 6 studies examined patients with mental illness, 9 studies examined elderly patients, and 4 studies examined other defined populations (pregnancy, trauma, liver transplantation, and hip arthroplasty). We summarize the qualitative findings of inpatient actigraphy as it relates to each of these populations. Commonly reported outcome measures were total sleep time (TST), number of nighttime awakenings, and concordance with polysomnography (PSG).
Conclusion: We summarize the existing evidence for the use of actigraphy in the inpatient setting. Actigraphy may provide a simple and effective method for screening of sleep disorders in the inpatient setting. With regard to the published literature, there is support for the use of actigraphy in the inpatient setting in certain patient populations, especially traumatic brain injury. Variation in data output of actigraphy devices and outcome measures presents a barrier to meta-anaylsis of pooled data. Standardization of outcome measures will allow for effective synthesis of future studies.
Support (if any):

721

A PANDEMIC'S IMPACT ON NIGHTMARE FREQUENCY

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Introduction: Nightmares have been defined as bad dreams that produce awakenings and have content which can be recalled upon awakening. Frequent nightmares have been linked to many negative outcomes, such as depression and suicide. Research has demonstrated that stress can impact the likelihood and frequency of nightmare occurrences. Furthermore, extreme stress (such as trauma) can produce chronically recurring nightmares. Given the rise in societal stress as a result of the Covid-19 pandemic, one could expect an increase in nightmares within the general population. With this in mind, our project sought to examine if nightmares are occurring more frequently during the Covid-19 pandemic.
Methods: Our project measured sleep quality and disordered symptoms in N = 2,126 undergraduate college students from the years 2017 to 2020 via online surveys. Data from 2020 was only gathered after the start of the Covid-19 pandemic (which was defined as March 11th 2020). Nightmares were assessed with a self-report questionnaire which asked, "have you experienced a nightmare within the past month", to which respondents could respond with "yes", "no", or "unsure". Prior to this question participants were told a nightmare is being defined as a bad dream that wakes one up and has remembered dream content upon awakening. Frequencies between years were compared using ANOVA techniques.
Results: In regard to the percentage of our sample that reported a nightmare during the previous month, the year 2020 was significantly higher (41.1%; $F = 10.27$, $p < 0.001$) than all other years assessed (2017 = 27.0%; 2018 = 25.3%; 2019 = 31.7%). Furthermore, there was no significant difference between any of the pre-Covid-19 years.
Conclusion: In 2020, A higher percentage of students reported experiencing a nightmare within the past month than any of our other captured years. Given our 2020 data only assessed students post the start of the pandemic, the significant increase of nightmares experienced by our sample could be related to stress produced by the Covid-19 pandemic. Considering that nightmares have been found related to several negative outcomes, such as depression and suicide, both assessment of, and treatments for nightmares may be especially needed during our current climate.
Support (if any): No support.

722

SLEEP LOSS IN HEALTHCARE WORKERS DURING THE COVID-19 PANDEMIC

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Introduction: During the pandemic, healthcare workers have shared their stresses on social media, including regarding sleep disturbances. However, an assessment of sleep using validated measures among healthcare workers on social media is lacking.
Methods: A restricted, self-selection survey was distributed on Facebook, Twitter, and Instagram for 16 days targeting healthcare workers who were clinically active during COVID-19. In addition to demographics and career information, participants completed the Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index. Poor sleep quality was defined as PSQI > 5. Moderate-to-severe insomnia was defined as an ISI > 14. Multivariate logistic regression tested the association between demographics and career characteristics and sleep outcomes.
Results: Of the 983 who clicked our link, 906 completed the survey. Participants were mostly white (70%), female (75%), physicians (64%). Mean sleep duration was 6.1 (SD1.2) hours. Nearly 90% experienced poor sleep (PSQI). One third reported moderate or severe

insomnia. Many (60%) reported sleep disruptions due to device usage or due to bad dreams at least once per week (45%). In multivariable regression, non-physicians (OR 3.5, CI: 2.5, 5.0), Hispanic ethnicity (OR 2.2; CI: 1.44, 3.45), being single (1.5, CI: 1.03, 2.21), and youngest age group (18–24) (OR 9.9; CI: 1.44, 68.09) had increased odds of insomnia. In open-ended comments, sleep disruptions mapped to 5 categories: (1) Work demands ("The volume of calls and messages from my patient and caregiver population is through the roof"); (2) Pandemic related ("I never had sleep issues prior to the COVID-19 pandemic. Suddenly I had issues with sleep initiation."; (3) Children and family ("COVID plus home stress plus stress over my kids, my job, my marriage."); (4) Personal health ("Insomnia predating COVID, but worsened with COVID."); (5) Responses to the pandemic ("I worry about how COVID is being managed by the President...This does keep me awake at night.").

Conclusion: During the COVID-19 pandemic, 90% of healthcare workers surveyed on social media reported poor sleep, with over one-third of participants reporting moderate-severe insomnia. Online sleep interventions for healthcare workers are urgently needed.

Support (if any):

723

SLEEP APNEA CARE DURING THE COVID-19 PANDEMIC: PERSPECTIVES ON THE TRANSITION TO TELEMEDICINE FROM CLINICIANS AND PATIENTS

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Introduction: Covid-19-related public health control measures have necessitated a rapid transition in healthcare delivery. We qualitatively explored clinicians' and patients' experiences of the pandemic's impact on the delivery and receipt of obstructive sleep apnea (OSA) care.

Methods: Between September and December 2020, we conducted ten 90-minute virtual focus groups with sleep clinicians (n=19) and English and Spanish-speaking patients with OSA (n= 30) recruited through an urban academic sleep clinic, national organizations, social media, and snowball sampling. An interdisciplinary team conducted a rapid qualitative analysis that included prefigured and emergent domains. The team developed a comprehensive analytic matrix, identifying key themes within and between groups and triangulating them across participant types.

Results: Clinicians and patients across all groups confirmed a rapid shift to the adoption of telemedicine. Clinicians reported telemedicine enhanced evaluations by enabling direct observation of the home environment, providing opportunities to guide patients on medical equipment used in the home, and cultivating meaningful social connections for patients. Perceived benefits varied across patient subgroups (age, language, technological self-efficacy). The majority of clinicians reported that telemedicine's initial uptake resulted in delays in care and revenue loss, but sustained use was thought to be feasible over time. Patients reported delays in care related to the pandemic's disruption on healthcare and their personal safety concerns. Additionally, telemedicine's adoption directly altered other elements of care, including the delivery of patient education materials and loss of tacit information gained during the in-person visit. All groups reported adequate mask fitting as a central challenge for patients using positive airway pressure therapy. Spanish-speaking patients noted concerns of increased difficulty accessing care and navigating the OSA care system due to limited English proficiency, in addition to the limited availability of OSA resources in Spanish.

Conclusion: During the Covid-19 pandemic, the rapid adoption of telemedicine largely facilitated OSA care but altered patient-clinician interactions, delivery of patient education materials, and mask fitting success. Given that telemedicine will likely be sustained post-pandemic, there are needs for targeted efforts aimed at addressing disparities in telemedicine, enhancing practitioner telepresence and education, and new approaches for mask fitting to ensure successful OSA care.

Support (if any): Patient-Centered Outcomes Research Institute EADI-16493

724

DOES COLORECTAL CANCER SITE INFLUENCE SLEEP QUALITY?

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Introduction: Understanding sleep quality among colorectal cancer (CRC) patients could contribute to improved survivorship care in terms of sleep recommendations.

Methods: We ascertained sleep quality within an ongoing population-based study of CRC patients identified through the Puget Sound SEER cancer registry. We assessed sleep quality using components of the standardized Pittsburg Sleep Quality Index. Differences in sleep quality by CRC site were analyzed using chi-square and ANOVA tests. We used logistic regression to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for the association of tumor site (rectal vs. colon) with sleep quality concerns. ORs were adjusted for age at diagnosis, sex, BMI, education, cancer stage, and time since diagnosis.

Results: Of the 1,454 CRC patients included in analyses, 37% (N=543) had rectal cancer compared to 63% (N=911) with colon cancer, and the stage distribution was as follows: 37% localized, 43% regional, and 18% distant stage. Overall, participants with rectal (vs. colon) cancer were more likely to report problems related to trouble sleeping (OR [CI]: 1.63 [1.23, 2.16]), but were also less likely to report trouble sleeping specifically due to issues with breathing, coughing, or snoring (OR [CI]: 0.51 [0.27, 0.96]. However, rectal cancer patients were more likely than colon cancer patients to report changes in sleep patterns after cancer diagnosis (OR [CI]: 1.33 [1.02, 1.73]), and to report trouble sleeping specifically due to getting up to use the bathroom (OR [CI]: 1.49 [1.17, 1.90]) or pain (OR [CI]: 1.50 [1.10, 2.04]). There were no significant differences between rectal and colon cancer cases in terms of amount of sleep, problems staying awake, bad sleep quality, and use of sleep medication.

Conclusion: Overall, rectal cancer patients are more likely to have sleep complications due to potential physical consequences compared to colon cancer patients. This suggests that survivorship care may be adapted according to CRC site to ensure patients receive appropriate support in terms of sleep recommendation.

Support (if any):

725

SERIOUS ILLNESS, SLEEP QUALITY, AND SPIRITUALITY: AN EXPLORATORY STUDY IN A MULTICULTURAL INPATIENT SETTING

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Introduction: Spiritual well-being can impact quality of life and survival among diseased populations, similarly to sleep. Despite beneficial effects of spiritual-based practices on sleep, few studies have investigated an association between these attributes. Our goal was to explore correlations between measures of sleep quality and spirituality among severe medical inpatients hospitalized for different reasons, testing whether sleep could be a mechanism by which spirituality influences clinical outcomes.
Methods: Patients (18+ years) admitted in two units of the University's hospital between Oct/2018 and Aug/2019 were invited to participate. Semi-structured interviews included the Duke Religiousness Index, the Belief into Action Scale, the Functional Assessment of Chronic Illness Therapy Spiritual Well-Being, the Pittsburgh Sleep Quality Index (PSQI), and the Short Form Six-Dimension (SF-6D) health index. Diagnoses were defined by the International Classification of Diseases. We used the Chi-square test, bivariate correlations, and Generalized Linear Models.
Results: A total of 146 consecutive patients were included (46.8±15.9 years, 51% men), 28% admitted for cardiovascular diseases, 26% for cancer, 20% rheumatologic disorders, and 26% for other conditions including hematological, nephro-urological, infectious, among other diseases. The mean PSQI was 10.1±4.7 and 55% of patients rated their sleep as poor. Average sleep duration was 6.5±1.9 hours. Insomnia (64%) was the most frequent sleep complaint, followed by nocturia (43%), pain (42%), and discomfort breathing (29%). There was a modest correlation between sleep quality and spiritual well-being (-0.23; $p<0.01$). Maintenance insomnia correlated with less spiritual peace/meaning (-0.27; $p<0.01$) and faith (-0.21; $p=0.01$), whereas pain, with more social (0.21; $p=0.01$) and private (0.24; $p<0.01$) religious activities. Initial insomnia also correlated with private activities (0.18; $p=0.04$). Seep quality (0.43; 0.25–0.62), spiritual peace/meaning (-0.21; -0.40-[-0.01]), and social religious activities (0.18; 0.04–0.32) were independent indicators of higher SF-6D scores, additional to an interacting effect between sleep quality and spiritual well-being predicting better quality of life.
Conclusion: Subjective sleep quality is associated with spiritual well-being and quality of life, independently of the nature and severity of the medical disease. Our findings also suggest that patients suffering from nocturnal pain and trouble falling asleep might be more engaged with religious activities.
Support (if any): Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

726

RELATIONSHIPS BETWEEN SLEEP AND PSYCHOLOGICAL ADJUSTMENT DURING THE COVID-19 PANDEMIC

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Introduction: Disruption of daily routines (employment, social interaction, health behaviors) during the COVID-19 pandemic has contributed to psychological distress (worry, rumination), likely impacting sleep-related behaviors. This study evaluated change in psychological adjustment and insomnia symptoms during the COVID-19 pandemic.
Methods: The sample included 192 adults from Utah who completed three data collection cycles across 9 consecutive months to assess self-reported depressive, anxiety, and insomnia symptoms. Anxiety and depressive symptoms were assessed via the Generalized Anxiety Disorder scale (GAD-7) and Patient Health Questionnaire depression scale (PHQ-8). Insomnia was measured by the Insomnia Severity Index (ISI). Data were analyzed using mixed-effect modeling and adjusted for anxiety and depression to determine their independent effects on insomnia symptoms. Spaghetti plots examined mean changes over time and significance was set at $p<0.05$. Average anxiety, depression, and insomnia severity scores were aggregated for each month.
Results: As participants' symptoms of anxiety and depression increased in severity, insomnia symptoms increased similarly. Over half of participants reported clinically significant ISI scores (59.38%). In both the random intercept and random slope models, there were significant independent effects of anxiety on insomnia severity ($F=20.69$; $p<0.0001$) and significant effects of depression on insomnia severity ($F=87.44$, $p<0.0001$). While the change in insomnia severity over time was on the boundary of statistical significance ($F=3.54$; $p=0.0618$), dropping from 15.17 (April) to 12.58 (December), our longitudinal analyses revealed no significant difference for the effect of anxiety or depression in predicting insomnia severity over time. Participants' monthly averages varied for sleep and psychological scores (ISI) from 12.58 to 16.07 (SD=3.76 to 6.34 for December and September, respectively), (GAD-7) from 3.47 to 6.39 (SD=3.36 to 5.26 for December and June, respectively), and (PHQ-8) 4.47 to 6.10 (SD=4.65 to 4.39 for December and June, respectively).
Conclusion: Results demonstrate high prevalence of insomnia symptoms during the COVID-19 pandemic and underscore the importance of examining mental health functioning and psychological resiliency on sleep in order to enhance prevention efforts in response to a significant stressor.
Support (if any):

727

IMPACT OF WASHINGTON STATE COVID-19 LOCKDOWN ON SLEEP

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Introduction: The COVID-19 pandemic caused a global disruption to daily routines. Studies using surveys and sleep-related applications on mobile devices suggest that the pandemic has contributed to increases in sleep disruption or onset of new sleep disturbances. We present results from a naturalistic at-home study in which objective sleep measurements were made using both a wrist actigraph (Actiwatch-2, Philips Respironics) and a non-contact monitoring device (SleepScore Max, SleepScore Labs), comparing sleep measurements obtained immediately before and after the start of the first mandatory COVID-19 stay-at-home order in Washington State.
Methods: As part of a larger study, nine Washington State residents (ages 22–48, 5 female, 4 male; 6 insomniacs, 3 normal sleeper) were enrolled in a 10-week at-home sleep monitoring study, which involved 1 week of actigraphy, 8 weeks of non-contact monitoring (data available for 6 subjects), and 1 week of actigraphy. During the study, the Washington State governor issued a stay-at-home order, effective March 15, 2020. We compared sleep measurements obtained before this date (mean ± SD: 25.0 ± 15.0 nights) and after this date (25.2 ± 13.9 nights) using mixed-effects ANOVA.
Results: Non-contact monitoring measurements indicated that after the start of the lockdown, participants woke up later by 63.2 ± 12.1 min (mean ± SE; $F[1,299]=27.40$, $p<0.001$) without significant change in bedtime ($F[1,299]=0.29$, $p=0.59$). Sleep latency lengthened by 4.0 ± 2.3 min ($F[1,295]=4.92$, $p=0.027$), and there were

increases in number of awakenings (F[1,295]=6.22, p=0.013) and wake after sleep onset (F[1,295]=12.58, p<0.001). Actigraphy data complemented these results, showing delayed sleep onset by 53.4 ± 15.1 min (F[1,101]=12.46, p<0.001) and delayed final awakening by 104.3 ± 19.6 min (F[1,101]=28.43, p<0.001), with longer sleep duration (F[1,101]=6.06, p=0.016), increased number of awakenings (F[1,101]=13.00, p<0.001), and a trend for increased intermittent wakefulness (F[1,101]=3.88, p=0.052) post-lockdown.

Conclusion: In this sample, we found evidence of increased sleep disruption following the first Washington State stay-at-home order related to COVID-19. Our findings are consistent with previous studies based on self-report data, which observed later wake times and decreases in sleep quality post-lockdown.

Support (if any): NIH grant KL2TR002317. Non-contact monitoring devices provided by SleepScore Labs.

728

SLEEP APNEA SCREENING IN INPATIENTS ADMITTED WITH ACUTE EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE: A FEASIBILITY STUDY

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Introduction: Obstructive sleep apnea (OSA) and Chronic obstructive airway disease (COPD) affect millions of Americans. The combination (overlap syndrome) results in increased morbidity, mortality and associated healthcare costs. Type III sleep testing via portable monitoring (PM) is not recommended for patients with COPD, and there is little guidance in regards to inpatient testing. We aim to determine the feasibility of inpatient PM for diagnosing OSA in patients admitted with acute exacerbation of COPD (AECOPD) and hypercapnic respiratory failure requiring noninvasive positive pressure ventilation (NIPPV).

Methods: This is a retrospective review of prospectively collected data. Inpatients 40 year-old and older admitted with AECOPD and PaCO2≥52mmHg on arterial blood gas (ABG) testing requiring NIPPV were included for analysis. One patient died and one withdrew consent. The remaining patients underwent overnight PM (ApneaLink Airtm by ResMed®) once clinically stable, off NIPPV, on oxygen when needed to sustain oxygen saturation at or above 88%. Patients were discharged on volume-assured pressure support ventilation (VAPS) for nightly use at home and followed for 6 months.

Results: Five patients were included. Average age was 60 years, majority were African-American males, former smokers (average 31.2 pack-years), with moderate to severe airflow obstruction (FEV1 24–52 %Pred). Except for one (BMI 17 kg/m2), patients had concomitant morbid obesity (average BMI 39.7 kg/m2). Four out of 5 patients had overlap syndrome (AHI 19.4/h -75/h). Follow-up objective download data demonstrated AHI <10 in all patients with available data (3/5 at 6 months). One patient required in-sleep center VAPS titration.

Conclusion: This pilot study suggests portable monitoring is feasible in diagnosing OSA in this complex patient population admitted for AECOPD, despite concomitant oxygen use during PM testing. Despite the small number of patients, 4/5 were diagnosed with moderate to severe OSA and objective data on VAPS demonstrated effective treatment. Further studies using PM for screening of OSA in inpatients with COPD and obesity and impact on patient-centric outcomes are needed.

Support (if any):

729

DAILY STRESS AND NIGHTMARES ARE BIDIRECTIONALLY ASSOCIATED AMONG NURSES

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Introduction: Nurses may experience frequent nightmares due to stressful work environments. Some studies estimate that 35% of nurses experience nightmares related to experiences at work. Nightmares may also exacerbate stress among nurses, although this has yet to be tested empirically. We examined daily bidirectional associations between stress severity and nightmare occurrence and severity, and whether posttraumatic stress disorder (PTSD) symptoms moderated those relationships.

Methods: 392 nurses (mean age = 39.54 years; SD = 11.15; 92% female; 78% White) were recruited for a larger study on sleep and vaccine response. For 14 days, upon awakening, nurses completed daily sleep diaries to assess previous-day stress severity (0 = not at all, 4 = extremely), as well as nightmare occurrence (0 = no nightmare, 1 = nightmare occurred) and nightmare severity (0 = not at all, 3 = very). PTSD symptoms were assessed at baseline using the PTSD Checklist of DSM-5 (PCL-5). Multilevel models were used to examine bidirectional, within-person associations between daily stress and nightmares, and cross-level moderation by baseline PTSD symptoms.

Results: Approximately 10.5% of nurses met criteria for PTSD based on PCL-5 scores. 47.2% of nurses reported at least one nightmare across the two weeks. Days with greater stress severity were associated with higher odds of experiencing a nightmare (OR = 1.22, $p = 0.001$), as well as greater nightmare severity that night ($b = 0.09$, $p = 0.033$). Nightmare occurrence ($b = 0.15$, $p < 0.001$) was associated with greater next-day stress severity. PTSD symptoms did not moderate daily stress and nightmare associations.

Conclusion: Nurses face intense occupational demands and frequent exposure to potentially traumatic events. Our results indicated nightmares and stress may occur in a bidirectional fashion among nurses. Results were similar regardless of nurses' PTSD status. Future studies should explore whether targeting nightmares and stress may improve nurses' health and well-being. Given the essential role that nurses play in maintaining patient health and safety, it is critical to understand the causes and consequences of their sleep-related disturbances.

Support (if any):

730

PREVALENCE AND IMPACT OF SLEEP PROBLEMS IN ACTIVE DUTY MILITARY PERSONNEL RECEIVING COGNITIVE PROCESSING THERAPY FOR PTSD

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Introduction: Sleep disturbances are common in active duty military personnel and play a key role in the development and maintenance of posttraumatic stress disorder (PTSD). Research indicates that although insomnia and nightmares improve with successful PTSD treatment, they may remain clinically significant. Few previous PTSD studies have assessed sleep disorder constructs using validated instruments. The objectives of this study were to examine the proportion of active duty military personnel seeking treatment for PTSD who reported clinically significant insomnia, nightmares, sleep duration, and excessive daytime sleepiness and to examine the impact PTSD treatment had on these sleep constructs using validated self-report questionnaires.

Methods: Sleep was evaluated in 223 active duty service members participating in a randomized clinical trial comparing group and individual Cognitive Processing Therapy (CPT) for PTSD. Sleep constructs were assessed using the Insomnia Severity Index (ISI), Trauma-Related Nightmare Survey (TRNS), Self-Assessment of Sleep (SAS), and Epworth Sleepiness Scale (ESS) at baseline and 2 weeks posttreatment.

Results: At baseline, 82% of participants reported clinically significant insomnia and 75% reported at least 1 moderately severe nightmare per week. Participants reported averaging 4.76 hours of sleep per night, and 65% reported excessive daytime sleepiness. Over the course of PTSD treatment, there were statistically significant improvements in insomnia, nightmares, and excessive daytime sleepiness, but scores remained in clinically significant ranges. Minimal increases were seen in sleep duration. Of the participants who no longer met criteria for PTSD at posttreatment, 50% continued to report clinically significant insomnia, 52% continued to report clinically significant nightmares, and 44% continued to report excessive daytime sleepiness.

Conclusion: Consistent with previous research, sleep problems persisted for a significant number of service members who completed treatment for PTSD. Insomnia, nightmare, and sleep extension interventions are likely an important part of comprehensive PTSD treatment plans.

Support (if any): Funding for this work was made possible by the U.S. Department of Defense through the U.S. Army Medical Research and Materiel Command, Congressionally Directed Medical Research Programs, Psychological Health and Traumatic Brain Injury Research Program awards W81XWH-08-02-109 (Alan Peterson), W81XWH-08-02-0116 (Patricia Resick), W81XWH-10-1-0828 (Daniel Taylor), and W81XWH-08-02-0114 (Brett Litz).

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WHO IS MOST AT RISK FOR NIGHTMARES? DEMOGRAPHIC AND PSYCHOSOCIAL DIFFERENCES IN NIGHTMARE PREVALENCE AMONG NURSES

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Introduction: Nurses are subject to stressful work environments, which may negatively impact their sleep and increase their risk for nightmares. Previous studies have shown that women, night shift workers, and individuals with comorbid psychological conditions are more likely to report nightmares. Yet no studies have comprehensively examined demographic and psychosocial factors of nightmares among nurses.

Methods: To address this gap, we examined demographic (age, gender, race, ethnicity, number of children, marital status, shift work status) and psychosocial (chronotype, PTSD, anxiety, depression, perceived stress) correlates of nightmares in a sample of 462 nurses (91% female; mean age = 39.03, SD = 11.07; 78% White; 10% Hispanic/Latinx). Nightmares were determined two ways: 1) using a newly validated retrospective survey measure, the Nightmare Disorder Index

(NDI), and 2) using aggregated prospective reports of daily nightmare frequency across 2 weeks (nurses who reported any nightmares in the past 2 weeks were classified as having nightmares).
Results: Nurses experiencing nightmares as determined by the NDI (n = 236; 51%) were younger, more likely to be female, less likely to have children, more likely to be an intermediate chronotype, less likely to be a morning chronotype, and had higher mean levels of PTSD, anxiety, depression, and perceived stress than nurses without nightmares. Nurses experiencing nightmares as determined by daily surveys (n = 191; 41%) were not different in terms of any demographic characteristics, but had higher levels of PTSD, anxiety, depression, and perceived stress than those nurses without nightmares.
Conclusion: Demographic and psychosocial differences in nightmare prevalence may differ based on how nightmares are assessed (i.e., retrospective vs. prospective measures). Overall, nurses with higher stress, PTSD, depression, and anxiety may be at greatest risk of having nightmares. Future studies should examine if targeting these factors results in improvements in sleep and well-being among nurses.
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A DAILY DIARY STUDY OF NIGHTMARE REPORTS AMONG COMBAT-EXPOSED VETERANS

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Introduction: Nightmare occurrences may, in part, result from prior-day arousal (e.g., the continuity hypothesis), and that they then influence next-day symptoms. Recent ecological momentary assessment (EMA) studies in samples of civilian trauma survivors found that elevated PTSD symptoms, pre-sleep cognitive arousal, and greater sleep onset latency predicted nightmare reports. This study adds to these works by using EMA in a sample of combat-exposed Veterans.
Methods: Data were analyzed from a study examining neurobiological and neuropsychological factors associated with PTSD in a sample of 27 combat-exposed OEF/OIF Veterans, with and without PTSD. Participants engaged in EMA for 6 days, with assessments across the day inquiring about mood, activity, and stressful events. Morning reports also included the consensus sleep diary and prompts on nightmare experiences. Those reporting nightmares were asked about nightmare disturbance and the level of replicability to a traumatic event (replays or symbolic/unrelated). Multi-level modeling analyses were used.
Results: A total of 113 morning reports were acquired, in which 40 included a report of having a nightmare and 73 did not. Main effects were found for baseline PTSD symptom severity (OR=1.13, p=0.02), prior day time spent alone (OR=0.01, p=0.01) and prior day level of distraction (OR=0.25, p=0.02) on morning reports of nightmares. However, when accounting for the previous night's nightmare report (OR=15.9, p<0.001), these effects were no longer significant. No other effects on nightmare reports were observed. Additionally, no factors predicted replicability of nightmare content or level of nightmare disturbance. Regarding daytime impact, nightmare reports were associated with greater levels of stress associated with events later that day (OR=2.48, p=0.04).
Conclusion: Greater baseline PTSD symptom severity, less daytime spent alone, and greater daytime attentiveness were significant predictors of nightmare reports. While daily social interactions and attentiveness may be beneficial, these factors also may be associated with hypervigilance, a known risk for sleep disruption. However, these data also suggest that day-to-day levels of stress may have less influence when a chronic nightmare pattern is present.
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PTSD AND SLEEP DISORDERS IN MEDICAL LEARNERS AND HEALTHCARE PROVIDERS

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Introduction: Medical student mental health and wellness has been an increasingly hot topic over the past decade. Much of the research, however, has remained focused more on anxiety and depression and less on other less common but just as detrimental mental health disorders such as PTSD, bipolar disorder, OCD and others. In addition to the more traditional psychological stresses medical students experience, they also experience physical consequences of their training, often with sleep patterns suffering most initially.
Methods: The questionnaire consists of thirty-five questions, compromising of demographic questions, questions relating to USMLE exams and education, the STOP-Bang Questionnaire, Epworth Sleepiness Scale, Fatigue Severity Scale and PTSD DSM-V Questionnaire. This survey was sent out between March and April of 2020 and was distributed to all medical students and residents with an LSU Health Shreveport email address via RedCAP, an encrypted electronic survey tool.
Results: A total of 78 participants responded to our survey, with 91.1% identifying as medical students and the rest as residents. 64.1%, identified as female, 34.6% identified as male and 1.3% declined to answer. While 43% of our participants found their educational experience emotionally traumatizing, 75% of them felt that preparing and/or taking USMLE exams was emotionally traumatizing. In regards the portions of our questionnaire that served as sleep disorder screening questions, the average score for the STOP-Bang was 1.48 (SD +/- 1.15) the average score for the ESS was 6.85 (SD +/- 4.72) and the average score for the FSS was 32.04 (SD +/- 11.99). It should be noted that, while the average score of the PTSD screening portion was 20.34 (SD +/- 17.47), 18 participants scored above 38, the minimum score needed to qualify for a PTSD diagnosis.
Conclusion: These results suggest some correlations that warrant further future study. It is worrisome that while less than half of our participants stated their educational experience as harrowing, 75% stated preparing for and/or taking these required exams was emotionally traumatizing. The possible connections suggested here between USMLE exams and an increase in fatigue, lack of motivation and PTSD symptoms urge us to look more closely at the impact of the USMLE.
Support (if any):

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PREVALENCE AND CORRELATES OF INSOMNIA IN VETERANS WITH AND WITHOUT MILITARY SEXUAL TRAUMA RECEIVING CARE WITHIN A VA MED CENTER

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Introduction: A prior study showed a higher prevalence of insomnia among younger Veterans with military sexual trauma (MST) before receiving care at a VA Medical Center (VAMC). We extend the literature to investigate the prevalence and correlates of insomnia in male Veterans with and without MST currently receiving care within a VAMC.
Methods: We evaluated cross-sectional data from a survey within the Philadelphia VAMC (N=138) using the following instruments: Insomnia Severity Index (ISI) total score for insomnia; Sexual Harassment Scale (DRRI-2) to screen for MST; PTSD checklist for DSM-5 (PCL-5) PTSD symptoms; Quick Inventory of Depressive Symptomatology-Self report (QIDS-SR) to evaluate depressive symptoms; Alcohol Use Disorder Identification Test (AUDIT-C) to assess for harmful drinking; and, the nightmare question from the PCL-5 scale to screen for persistent nightmares. The association between ISI total score and variables were assessed separately in individuals with and without MST, using bivariate and multivariable analyses.
Results: The mean(SD) age was 55.2(12.8) years. They were likely to identify themselves as African-American (44.2%), and had a high school diploma (39.1%). MST was endorsed by 31.9% of the Veterans. Insomnia was more prevalent in those with MST [N=42(95.4%)] than those without [N=77(81.9%)]. Individuals with MST had higher ISI (19.9±5.0 Vs 16.7±7.2) and PCL-5 (48.4±14.4 Vs 38.1±19.7) total scores, than individuals without. Among those with MST, the bivariate analysis showed significant associations with PCL-5 (β=0.2, p<0.0001), QIDS (β=0.5, p=0.01), AUDIT-C (β=0.5, p=0.008), and nightmares (β=3.9, p=0.03). In the multivariable model, ISI total score was only associated with the PCL-5 total score (β=0.3, R2=0.18, p=0.0005). Among those without MST, the bivariate analysis showed significant associations between ISI total score and age (β=-0.1, p=0.02), total scores on the PCL-5 (β=0.2, p<0.0001), QIDS (β=0.9, p<0.00001), and nightmare (β=6.7, p<0.0001). In the multivariable model (R2=0.5, p<0.00001), the ISI total score was associated with PCL-5 (β=0.1, p=0.01), and QIDS (β=0.7, p=<0.0001) total scores.
Conclusion: There is a higher prevalence of insomnia among Veterans with MST currently receiving care within the VHA. Treatment of insomnia and PTSD is critical to improve their well-being and prevent complications.
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NEIGHBORHOOD STRESS PREDICTS FEAR OF SLEEP INDEPENDENTLY OF POSTTRAUMATIC STRESS DISORDER

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Introduction: Chronic insufficient sleep is linked to a variety of adverse health outcomes, with African Americans reporting and objectively receiving poorer sleep outcomes in comparison to their non-Hispanic white counterparts. African Americans live disproportionately in low-income and disordered neighborhoods that increase one's risk of experiencing a traumatic event and interfere with sleep. It has been demonstrated that posttraumatic stress disorder disrupts sleep in part due to its association with sleep-related fears. However, less research has evaluated the additional contribution of perceived neighborhood stress on the sleep-related fears African Americans experience in their sleep environments.
Methods: The present study features a nonclinical sample of 163 African American participants (ages 18–35) who reside in DC to investigate whether PTSD severity (Clinician Administered PTSD Scale for DSM-5 Severity Score, CAPS-5) and perceived neighborhood stress (City Stress Index, CSI) are predictive of sleep-related fears (Fear of Sleep Inventory, FoSI).
Results: After controlling for gender, hierarchical linear regression analyses revealed that PTSD severity and perceptions of the neighborhood environment accounted for approximately 33% of the variance in sleep-related fears (ΔR2 = .329, p = .000). Regression coefficients suggest that subjective perceptions of the neighborhood (β = .388) may be a stronger predictor of sleep-related fears than PTSD severity (β = .300)
Conclusion: Results from this study have implications for future interventions that involve improving coping skills among African Americans in the context of their sleep environments.
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EVALUATION OF SUVOREXANT FOR TRAUMA-RELATED INSOMNIA

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Introduction: Finding medication treatment that improves sleep disturbances with posttraumatic stress disorder (PTSD) has challenged the field of psychopharmacology with debate regarding the desirable profile of effects on sleep physiology. Evidence for fragmentation of REM sleep during the earlier stages of PTSD drew our interest to the first marketed dual orexin antagonist, suvorexant, which has been suggested in some studies to enhance REM sleep. This property has also raised concerns regarding potential exacerbation of nightmares and REM sleep related parasomnias. Insomnia is a common sequela of trauma exposure and can occur with and without other PTSD symptoms. The objective of our study was to evaluate the tolerability and preliminary efficacy of suvorexant for trauma related insomnia in a double blind, placebo controlled trial.
Methods: 64 met initial inclusion criteria and 42 participants had evaluable results. 65% were female, and 66% African-American, mean age was 35yrs.All participants were screened by the Duke Sleep Disorders Interview to met criteria for insomnia that began or was exacerbated following a DSM5 Criterion A trauma. Approximately a third of the study group met criteria for either current PTSD, past (remitted PTSD), or no PTSD, and 56% reported histories of traumatic nightmares hat generally had diminished from their initial severity.
Results: Medication intolerance was infrequent with one participant in the med group reporting mild sedation that precluded a dose increase to 20mg, and another, moderate sedation with feelings of derealization that led to discontinuation. There was no evidence for emerging nightmare symptoms or REM-related parasomnias. Overall there was significant improvement in sleep and PTSD symptoms in both the placebo and med group and a modest rise in REM sleep in the med group that did not differentiate statistically from placebo.
Conclusion: Our findings suggest that distressing trauma related insomnia can occur with and without PTSD and that suvorexant is well tolerated in this population. A larger and more symptomatic group is required to more definitively evaluate efficacy.
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PREDICTION OF DROP OUT IN AN ADJUNCTIVE LIGHT TREATMENT TRIAL IN PATIENTS WITH NON-SEASONAL DEPRESSION AND EVENING CHRONOTYPE

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Introduction: Drop out during treatment hampers therapeutic effect of interventions. The current study examines the possible predictors of drop out during the five-week light treatment in patients with unipolar non-seasonal depression and evening-chronotype.
Methods: Baseline characteristics including demographics, sleep diary parameters, light treatment prescribed, and early clinical outcomes changes were compared between the Drop out and Non drop out group. Logistic regression analysis was used to examine predictors for drop out. All data were analyzed in a modified intention to treat analysis with last observation carried forward approach.
Results: A total of 91 subjects (Female 79%, 46.3 ± 11.8 years old) were included in the analysis. There was no significant difference in the baseline demographic and clinical characteristics between the Drop out and Non drop out group. There was also no significant difference in the improvement of clinical parameters over the first week among the two groups. However, treatment non-adherence (in terms of compliance of less than 80% of prescribed duration) over the first treatment week predicts a five-fold increase in risk of drop out during light therapy. (OR: 5.85, CI: 1.414–24.205, p=0.015) after controlling for potential confounders including age, gender, treatment group, patient expectation, and treatment-emergent adverse events.
Conclusion: This study found that baseline clinical characteristics including depression severity and improvement of depressive symptoms in the initial week did not differ between the Drop out and Non drop out group. The drop out was also not affected by the type of light (dim red versus bright red light), indirectly supporting dim red light as a valid placebo in bright light therapy trial. Treatment adherence is the early phase of light treatment is an important predictor of drop out.
Support (if any):

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EFFECTS OF EXOGENOUS MELATONIN ON SLEEP, CIRCADIAN RHYTHMS, AND MOOD IN WOMEN WITH PREMENSTRUAL DYSPHORIC DISORDER

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Introduction: Most women with premenstrual dysphoric disorder (PMDD) report sleep disturbances. Our group found normal polysomnographic (PSG) sleep efficiency and increased slow wave sleep (SWS) across the menstrual cycle in women with PMDD and insomnia compared to controls. Reduced melatonin levels were found in PMDD women compared to controls, with reduced secretion during their luteal phase (LP) compared to follicular phase (FP). Here, we investigated the effects of exogenous melatonin in the patients we previously studied.
Methods: Five patients (age, mean: 33.6, SD: 2.7) diagnosed prospectively with PMDD and insomnia participated in the study. Following a baseline assessment, patients took 2 mg of slow-release melatonin 1h before bedtime during their LP for three consecutive menstrual cycles. At baseline (treatment-free condition), patients spent every third night of their menstrual cycle sleeping in the laboratory. Measures included morning urinary 6-sulfatoxymelatonin (aMt6), PSG sleep, nocturnal core body temperature (CBT), visual analogue scale for mood (VAS-Mood), Prospective Record of the Impact and Severity of Menstrual symptoms (PRISM), subjective sleep and ovarian hormones (estrogen and progesterone). Participants also underwent two 24-hour intensive physiological monitoring (during the FP and LP) in time-isolation/constant conditions to determine 24-hour plasma melatonin and CBT rhythms. The same measures were repeated during their third menstrual cycle of melatonin administration.
Results: In the intervention condition compared to baseline, we found increased urinary aMt6 ($p<0.001$), reduced objective SOL ($p=0.01$), SWS ($p<0.001$) and increased Stage 2 sleep ($p<0.001$). Increased urinary aMt6 was associated with reduced SWS ($r=-0.51$, $p<0.001$). Circadian parameters derived from 24-hour plasma melatonin and CBT did not differ between conditions, except for an increased melatonin mesor in the intervention condition ($p=0.01$). Ovarian hormones were comparable between the conditions ($p\geq0.28$). Symptoms improved in the intervention condition, as measured by the VAS-Mood ($p=0.02$) and the PRISM ($p<0.001$).
Conclusion: We have shown normalization of SWS and reduction in self-reported mood and somatic symptoms after administrating exogenous melatonin in women with PMDD. These findings support a role for disturbed melatoninergic system in PMDD that can be partially corrected by exogenous melatonin.
Support (if any): This study was supported by the Canadian Institutes of Health Research (CIHR)

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ASSOCIATION OF HOSPITAL-DIAGNOSED SLEEP DISORDERS WITH SUICIDE: A NATIONWIDE COHORT STUDY

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Introduction: Sleep disorders and psychiatric disease are closely related, and psychiatric diseases are associated with elevated suicide risks. Yet, it is not clear if sleep disorders are associated with suicide as previous studies were limited by self-reported measures. The aim of this study was to examine whether people with a hospital-diagnosis of sleep disorders had higher suicide rates than people with no diagnosis.
Methods: Using a retrospective cohort design, national data on all persons aged 15 years and over who lived in Denmark during 1980–2016 (males: 3,674,563, females: 3,688,164) were obtained. People with sleep disorders were identified in somatic hospital registers. The main outcome was death by suicide as recorded in the Danish Cause of Death register. Incidence Rate Ratios were obtained using Poisson regressions while adjusting for relevant covariates.
Results: Out of 23,927 male and 11,556 female suicide deaths, 299 and 117 had been diagnosed with a sleep disorder, respectively. Males with sleep disorders had a suicide rate of 47.4 (95% CI, 42.0–52.7) per 100,000 person-years compared to 29.9 (95% CI, 29.5–30.3) among those with no sleep disorders. For females the respective rates were 42.3 (95% CI, 34.7–50.0) versus 13.9 (95% CI, 13.6–14.1). An adjusted IRR of 1.6 (95% CI, 1.4–1.7) and 2.2 (95% CI, 1.8–2.6) was noted among males and females with sleep disorders, respectively, when compared to those with no disorders. Excess rates were noted with respect to insomnia, narcolepsy and, in males, sleep apnea. A difference with respect to age and sex was observed ($p<0.001$). Furthermore,IRRs of 4.1(95% CI, 3.1–5.5) and 7.0 (95% CI, 4.8–10.1) were noted for males and females, respectively, during the first 6 months of diagnosis when compared to those not diagnosed. The association between sleep disorders and suicide remained significant when adjusting for psychiatric disorders, although those with psychiatric disorders also had elevated rates, particularly amongst females.

Conclusion: In this study, individuals with sleep disorders had an increased suicide rate when compared to those with no sleep disorders. Higher suicide rates were found for individuals suffering from narcolepsy, insomnia and sleep apnea. More attention towards risks of suicide among people with sleep disorders might be needed.
Support (if any):

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INSOMNIA, COGNITIVE AROUSAL, AND PERINATAL-FOCUSED RUMINATION FUEL PERINATAL DEPRESSION

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Introduction: Depression is among the most prevalent perinatal complications, yet modifiable risk factors remain elusive. Over half of perinatal women endorse clinical insomnia symptoms, which are etiologically implicated in depression in non-perinatal samples. Yet, prospective data on perinatal insomnia and depression are mixed. We sought to clarify temporal associations of insomnia and depression during peripartum, and to investigate cognitive arousal as a potential mechanism facilitating this relationship.
Methods: Seventy pregnant women completed sociodemographic information and baseline sleep and mood symptoms between gestational weeks 25–30. Beginning at gestational week 30, participants completed 17 weekly online surveys assessing insomnia, depression, and three cognitive arousal indices (nocturnal cognitive arousal, perseverative thinking, perinatal-focused rumination). Mixed effects models were conducted to test hypotheses.
Results: Women were at elevated risk of screening positive for depression when experiencing high levels of insomnia (OR=2.36, 95%CI=1.28, 4.35), nocturnal cognitive arousal (OR=3.05, 95%CI=1.60, 5.79), perinatal-focused rumination (OR=2.05, 95%CI=1.11, 3.79), and perseverative thinking (OR=7.48, 95%CI=3.90, 14.32). Prospective analyses revealed bidirectional effects between insomnia and cognitive arousal, and both predicted future depression. Nocturnal cognitive arousal mediated 23–43% of the effect of insomnia on depression. Insomnia mediated 12–18% of the effect of nocturnal cognitive arousal on depression. A similar pattern was observed with perinatal-focused rumination. Depression did not predict insomnia.
Conclusion: Perseverating at night, particularly on perinatal concerns, fuels insomnia. In turn, lying awake at night provides ample opportunity for perseverating. This cycle feeds perinatal depression. Daytime cognitive arousal may indirectly disrupt sleep as perseverating during the day persists into the night.
Support (if any):

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SLEEP AND POSTPARTUM DEPRESSION IN HEALTHY FATHERS: PERCEPTIONS OF SLEEP QUALITY PREDICT SEVERITY OF SYMPTOMS

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Introduction: Research on the link between sleep quality and depression in the postpartum period has focused primarily on mothers. Although fathers also experience poorer postpartum sleep and are at risk of developing depressive symptoms, they remain understudied. To date, the limited research focusing on paternal sleep and depression has relied on subjective measures of sleep, without objective verification. The current study implemented a multi-measure approach using subjective and objective indices to explore the relationship between sleep and depressive symptoms in fathers at 6 months postpartum.
Methods: Fifty-four healthy fathers participated in this cross-sectional study. Paternal sleep was assessed for 2 weeks utilizing: 1) a self-report daily sleep diary, 2) a self-report perceived sleep quality rating, and 3) actigraphy. Subjective indices via the sleep diary measured participants' perception of their total nocturnal sleep duration and total number of awakenings (self-reported sleep duration and fragmentation). Perceived sleep quality ratings measured participants' perceptions of how well they thought they slept. Objective sleep variables measured through actigraphy included: total nocturnal sleep duration, number of awakenings, sleep efficiency, and wake after sleep onset (WASO). Paternal depressive symptoms were assessed with the Center for Epidemiologic Studies – Depression Scale (CES-D).
Results: Regression analyses showed that subjective sleep variables (measured by the sleep diary) and objective sleep variables (measured by actigraphy) did not significantly predict postpartum depressive symptoms in fathers ($p > .05$). However, self-reported perceived sleep quality significantly predicted postpartum depressive symptom severity in fathers ($R2 = .172$, $p = .034$).
Conclusion: These findings advance our understanding of the link between sleep and depression in fathers. The results highlight the important role of fathers' perceptions of sleep quality, rather than the actual quality or quantity of their sleep (measured through the sleep diary or actigraphy), in the development of postpartum depressive symptoms. The multi-measure approach to sleep implemented in this study expanded our knowledge about how different facets of sleep relate to depression. These findings have important implications for the development of clinical interventions targeting paternal sleep and mood in the months following childbirth.
Support (if any): Social-Science and Humanities Research Council (SSHRC) and Fonds de recherche du Québec – Santé (FRQS)

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LINKAGES BETWEEN SLEEP QUALITY AND MENTAL HEALTH AMONG COUPLES COPING WITH TYPE 1 DIABETES ACROSS SURVEY AND DAILY DIARY METHODS

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Introduction: Sleep serves an important role in maintaining and promoting metabolic and mental health. The interdependent nature of couple relationships makes examining sleep quality from a dyadic perspective critical. This study examined the effect of sleep quality on mental health among couples coping with type 1 diabetes across survey and daily diary methods and investigated whether relationship satisfaction moderated these relations.
Methods: 199 persons with type 1 diabetes (Mage = 46.82) and their spouses (Mage = 46.41) completed one survey questionnaire reporting their own sleep quality (PSQI), depressive symptoms (CESD), and relationship satisfaction (CSI). They also completed 14-day diaries reporting on their own sleep quality and negative affect. The actor-partner interdependence model and multi-level model were used to examine the effect of sleep quality on mental health across the cross-sectional and daily diary surveys. Multi-level modeling examined effects of within-person and between-person effects of sleep quality on next-day daily negative affect (controlling for prior day affect).

Results: Cross-sectional survey data revealed an association between poorer global sleep quality and higher depressive symptoms for both partners (actor effects). Spouses' poorer sleep quality was associated with higher depressive symptoms for persons with T1D (partner effects). Daily diary data demonstrated an association between within-person and between-person effects of own poor sleep quality and higher negative affect for both partners. Poorer daily sleep quality for persons with T1D was associated with higher negative affect for spouses (partner effects). When examining the moderating role of relationship satisfaction, spouses' poorer overall sleep quality was associated with greater depressive symptoms and overall negative affect respectively for those with lower relationship satisfaction but not for those with higher relationship satisfaction across both methods.
Conclusion: Findings support the conceptualized link between sleep quality and mental health as both an intraindividual and dyadic process among couples coping with T1D across survey and daily diary methods. Additionally, better relationship satisfaction may buffer the effect of overall poor sleep quality on mental health for spouses.
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DIFFERENCES IN THE PREVALENCE OF SLEEP DISTURBANCE AND ASSOCIATED RISK FACTORS IN ALCOHOL USE DISORDERS AND MAJOR DEPRESSION

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Introduction: Sleep disruption is common in patients with alcohol use disorders (AUD) and major depressive disorders (MDD). Our understanding of the differences in the rates of sleep disturbance and overall sleep duration in patients with AUD, MDD, and comorbid AUD and MDD is limited. Furthermore, it is unknown whether there is variation in demographic and clinical characteristics associated with sleep disturbance and duration in these diagnostic groups.
Methods: This study utilized data from the UK Biobank (UKB). Depression status was determined based on review of International Classification of Diseases (ICD) codes and health records. AUD status was based on AUDIT scores (score ≥8 was defined as AUD) and sleep disturbance was evaluated utilizing a self-reported questionnaire. The sample was categorized into those with MDD alone (MDD+/AUD-)(n=18,154), AUD alone (MDD-/AUD+)(n=6123), both (MDD+/AUD+)(n=9027), and controls with neither (MDD-/AUD-)(n=27,573). We used generalized linear models (GLMs) to compare rates of sleep disruption and duration among the groups and determine the clinical predictors of sleep disturbance/duration in the four groups as well as test whether these factors differed among the groups.
Results: The prevalence of sleep disturbance in the control sample (MDD-/AUD-) was 26.4% and the self-reported sleep duration in this sample was 7.209±0.919. Subjects with AUD and/or MDD had greater rates of sleep disturbance and shorter sleep duration. Among the different diagnostic categories, the prevalence of sleep disturbance was highest in subjects with MDD+/AUD+ (36.5%) followed by those with MDD+/AUD- (35.6%) and MDD-/AUD+ (27.9%)(all $p<0.0001$). Similarly, the sleep duration was shortest in subjects with MDD+/AUD+ (7.143±1.016), followed by MDD+/AUD- (7.158±1.050) and by MDD-/AUD+ (7.202±0.891)(all $p<0.0001$). Subjects with sleep disturbance were more likely to be older, female, and with higher body mass index, Townsend deprivation index, and neuroticism scores across all four groups (all $p<0.05$).
Conclusion: In a large population-based cohort, MDD with and without comorbid AUD was associated with greater rates of sleep disturbance and shorter sleep duration than AUD alone. The clinical and demographic factors associated with sleep disturbance did not differ in these diagnostic categories, indicating possible similar underlying risk factors.
Support (if any): NA

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CORRELATES TO IMPROVEMENT IN SLEEP IN ACUTE MANIA

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Introduction: Sleep disruption and reduced sleep duration are potential triggers and also core symptoms of a manic episode. Our understanding of how sleep duration changes during the course of a manic episode and its potential association with symptom improvement is limited. We examined the natural course of sleep duration and its association with time to discharge and other clinical and demographic factors in patients with mania.
Methods: This was a retrospective study conducted in patients admitted to an acute care psychiatric unit with a manic episode. Sleep duration was determined based on observer report as logged by nursing staff. Sleep duration at admission and discharge were determined by averaging the total sleep time on day 2/3 of hospitalization and day 3/2 preceding discharge date. We obtained data on possible confounders including antipsychotic (chlorpromazine equivalents), benzodiazepine (diazepam equivalents) and other hypnotic medication doses administered at admission and discharge. We examined the associations between the change in sleep duration from admission to discharge with length of hospitalization and other clinical and demographic characteristics.
Results: The sample consisted of 35 patients (54.3% male) aged 32 ± 9.96 years with an average length of hospitalization of 20.63 ± 18.62 days. The mean sleep duration on admission was 6.23 ± 1.77 hours and was 7.45 ± 1.49 hours on discharge, with a mean change of 1.23 ± 1.93 hours. The change in sleep duration was positively correlated with length of hospitalization ($r=0.42$; $p=0.01$). Other clinical factors including benzodiazepine or antipsychotic dose on admission, age, sex, and use of mood stabilizers were not correlated with the change in sleep duration.
Conclusion: There was a substantial improvement in the total sleep duration in patients with mania over the course of hospitalization. Overall, the change in sleep duration was only correlated to the length of stay and did not appear to be impacted by other clinical and demographic characteristics.
Support (if any):

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ASSOCIATION OF LONGITUDINAL SLEEP PROFILES WITH COGNITIVE FUNCTIONING IN BIPOLAR DISORDER

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Introduction: Emerging evidence suggests that some cognitive deficits in bipolar disorder may be attributed to sleep disturbance. However, current findings are limited by cross sectional analyses or

longitudinal studies with sparse follow up on sleep quality. The current study examined longitudinal profiles of sleep as predictors of cognitive performance across a series of domains to better understand how sleep disturbance may impact in bipolar patients.

Methods: 241 bipolar disorder and 103 control participants had their sleep measured at baseline, 6- and 12-months using the Pittsburgh Sleep Quality Index (PSQI). Individuals with a "poor" categorical PSQI sleep rating (PSQI total score >5) at all time points were categorized as "Poor Sleepers" (n = 134). Those rated "good" at each time point were "Healthy Sleepers" (n = 107), and those with at least one discrepant sleep rating at any time point were labeled "Unstable Sleepers" (n = 103). Cognitive performance was assessed at 12-months, testing domains of memory, processing speed, and executive function. ANOVAs controlling for demographics, mood symptom severity, and diagnostic group examined effects of sleep profiles on cognitive function.

Results: Main effects for sleep group were found for the California Verbal Learning Test across all short and long delay recall conditions (F's 4.45 – 5.8, p <.02 for all). The poor sleep group performed the worst, while no main effects for diagnosis were observed. Main effects of sleep group were found for time conditions of the Trail making task (F = 4.18, p = .016), but not for errors.

Conclusion: Sleep quality was more strongly related to verbal and visual memory than bipolar diagnosis, with weaker effects for executive function. Some cognitive domains in bipolar disorder may be more closely related to sleep disturbance than endogenous factors. Future studies should explore how improvements in sleep functioning relate to neurocognitive outcomes, and whether cognitive performance varies as a function of sleep instability independent of mood instability.

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DELAYED RHYTHM IS ASSOCIATED WITH ENHANCED DISCRIMINATION FOR NEGATIVE EMOTIONAL INFORMATION

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Introduction: Mnemonic discrimination, the ability to differentiate novel and highly similar but not identical stimuli, is negatively associated with sleep deprivation and depression. Depression is additionally associated with increased discrimination specifically for negative emotional stimuli. While sleep and circadian activity rhythm (CAR) disturbances are common in depression and have been reported to have negative impact on hippocampal-dependent memories, their relationship with emotional discrimination has yet to be investigated.

Methods: As part of a larger study, 14 patients with DSM-5 major depressive disorder (22.9±4.1 years, 71.4% female) and 13 healthy controls (29.4±8.5 years, 61.5% female) were evaluated with wrist-actigraphy (7–14 days) and completed an emotional discrimination task. Lure discrimination index (LDI) for each emotion type (i.e., negative, neutral, and positive) was calculated to indicate how well participants discriminated among highly similar lures. Actigraphy-derived sleep parameters included total sleep time (TST), sleep efficiency (SE), and midsleep time. Minute-by-minute actigraphy-derived activity counts were used to characterize CAR and parametrized using cosinor analysis and Generalized Additive Models (GAM) deriving the rhythm Acrophase, Amplitude, UP time, and DOWN time. A repeated measures ANOVA (within-subjects: emotion, between-subjects: group) assessed whether mnemonic discrimination differed between patients with MDD and controls. Partial correlations examined the association between sleep and CAR parameters with mnemonic discrimination, while controlling for age, state anxiety, depression severity, TST, and groups.

Results: We found a significant effect of emotion [$F(2,90)=3.25$, $p=0.043$], where neutral information was remembered better than emotional information (p's<0.005); no significant effect of group (MDD vs. control) was observed. Midsleep time and Acrophase were each positively associated with negative LDI ($r=0.576$, $p=0.008$; $r=0.540$, $p=0.014$, respectively). Exploratory GAM results suggested a significant positive correlation between UP time and negative LDI ($r=0.497$, $p=0.022$). TST, SE, Amplitude or DOWN time was not associated with LDIs.

Conclusion: Delayed CAR, characterized by latter midsleep time and delayed acrophase and peak time of the morning activity, is associated with increased discrimination for negative emotional information, independent of depressive symptom severity. Future studies are needed to replicate these findings and further explore the potential cognitive benefits of adjunctive interventions addressing sleep/CAR in mitigating symptoms of depression.

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SUICIDAL IDEATION ASSOCIATED WITH COGNITIVE HYPERAROUSAL, RUMINATION AND INSOMNIA IN DEPRESSED PERINATAL WOMEN

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Introduction: This prospective study explored associations among clinical insomnia, nocturnal cognitive hyperarousal, and nocturnal perinatal-focused rumination with suicidal ideation (SI) in perinatal women with mild-to-moderate depression.

Methods: From late pregnancy through early postpartum, 39 women with depression completed 17 weekly surveys assessing insomnia, depression, suicidal ideation, perceived stress, and three cognitive arousal indices.

Results: Women with nocturnal cognitive hyperarousal at baseline, relative to those with low nocturnal cognitive arousal, were at greater risk for developing new onset SI in late pregnancy or early postpartum (33% vs 1%). Moreover, nocturnal perinatal-focused rumination was independently associated with SI. SI-risk was highest when women reported clinical insomnia combined with nocturnal cognitive hyperarousal (OR=5.66, p=.037) or perinatal-focused rumination (OR=11.63, p=.018). Daytime perseverative thinking was not uniquely associated with SI.

Conclusion: Cognitive hyperarousal and perinatal-focused rumination at night are uniquely associated with SI among perinatal women with depression. Moreover, insomnia augments the suicidogenicity of nighttime cognitive activity. Future research should determine whether alleviating nocturnal cognitive arousal, pregnancy- and fetal/infant-related concerns, and insomnia with psychotherapy reduces SI for women with perinatal depression.

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IMPACT OF DEEP TRANSCRANIAL MAGNETIC STIMULATION ON INSOMNIA COMORBID WITH TREATMENT RESISTANT DEPRESSION

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Introduction: Deep Transcranial Magnetic Stimulation (dTMS) is an FDA-approved non-invasive brain stimulation treatment for management of treatment-resistant depression (TRD). However, the efficacy of dTMS on Insomnia, a commonly prevalent and one of the most refractory symptoms of depression, is not clearly established. Our study aims to assess the impact of dTMS on outcomes of insomnia comorbid with TRD.
Methods: Single center retrospective study examining mood and insomnia outcomes in TRD patients (n=25), with greater than 3 failed psychotropic medication trials, undergoing dTMS for unipolar major depression.. Questionnaires including Patient Health Questionnaire (PHQ-9), Insomnia Severity Index (ISS),Generalized Anxiety Disorder-7 (GAD-7) were compared at baseline and at the end of dTMS treatment course.
Results: TRD patients with 'low insomnia' (n=12; ISS=7.9) and 'high insomnia' (n=13; ISS=20) were examined in terms of mood and insomnia ouctomes. No significant differences at baseline were noted between two groups in terms of demographic, mood, and anxiety variables. Depression and anxiety symptoms for patients in 'Low Insomnia' group significantly improved from baseline to final dTMS session- PHQ-9 [$t(11) = 6.021$, $p < .0001$]], GAD-7 [$t(11) = 2.389$, $p = .036$]. TRD patients in 'High Insomnia' group also reported significant improvements in depression [$t(12) = 5.596$, $p < .0001$], anxiety [$t(12) = 2.743$, $p = .018$], and insomnia [$t(12) = 6.057$, $p < .0001$]] at final dTMS session as compared to baseline. Non-responders in 'High Insomnia' group did not achieve statistically significant improvements in either depression or insomnia outcomes.
Conclusion: Insomnia comorbid with TRD responds to treatment with dTMS irrespective of the insomnia severity at baseline. Prospective research with the use of objective assessment measures for insomnia is warranted to confirm these findings. Non-response to insomnia was associated with poor mood outcomes as well in TRD patients. The probable mechanistic action of insomnia improvement in patients with TRD undergoing dTMS is unclear and further systematic research to understand the clinical and neural correlates of insomnia response with dTMS is needed.
Support (if any): N/A

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IS DAYTIME SLEEPINESS A RISK FACTOR FOR DEPRESSION AND THE PREVALENCE OF DEPRESSION IN PATIENTS WITH EDS REFERRED FOR PSG.

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Introduction: Excessive daytime sleepiness affects 18.9–27% of the general population. [1] Patients with excessive daytime sleepiness have a higher prevalence of major depressive episodes. [2] Depression is also associated with poor medical compliance which may further affect management of excessive day time sleepiness. [3] We therefore are interested in the prevalence of depression in patients undergoing in-lab testing for excessive sleepiness and the association of positive depression screening.
Methods: Retrospective review of diagnostic polysomnograms (PSG) in a tertiary care facility was conducted on patients over 18 years of age. The elements collected include: gender, age, BMI, Depression scale defined by PHQ-9, EDS defined by Epworth's Sleepiness scale, AHI = Apnea Hypopnea Index, PLMS = Periodic Limb Movements in Sleep.
Results: There were a total of 32 subjects. Median age was 49 with 43% male and average BMI of 35. The mean PHQ-9 score was 5.8. The mean Epworth score was 8.5. The correlation of the two values was r= 0.078. 12 patients are classified as having EDS. 7 patients (58.3%) in the EDS group were positive for depression screen. 18 patients (90%) without EDS were positive for depression screen. There is no statistical difference 2 groups (58.3% vs 90%, p=1). The mean PHQ-9 score in EDS group is 5.5. The mean PHQ-9 score in non EDS group is 5.95. There is no statistical difference between 2 groups PHQ-9(5.5 vs 5.95, p=0.779).
Conclusion: Our study cohort did not find a correlation between subjective sleepiness and depression in individuals presenting for in lab polysomnography. This may be related to the sample size or be an indication that many other factors contribute to the sleepiness in this cohort.
Support (if any): 1. Hein M. et al (2019) Prevalence and risk factors of excessive daytime sleepiness in major depression: A study with 703 individuals referred for polysomnography. J Affect Disord. 2. Chellappa SL. et al (2006) Excessive daytime sleepiness in patients with depressive disorder. Braz J Psychiatry. 3. Grenard JL et al (2011) Depression and medication adherence in the treatment of chronic diseases in the United States: a meta-analysis. J Gen Intern Med

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SLEEP DISTURBANCES MEDIATES THE ASSOCIATION BETWEEN EMOTIONAL LABOR AND DEPRESSIVE SYMPTOMS AMONG HEALTHCARE WORKERS

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Introduction: Depression is the second leading cause of disability worldwide. Healthcare workers report a higher prevalence of depressive symptoms than the general population. Emotional labor has contributed to poor health and work outcomes. However, the mechanism for the potential association between emotional labor and depressive symptoms has not been well studied.
Methods: In 2018, healthcare workers (n=1,060) from five public sector facilities in the northeast U.S. participated in this cross-sectional survey. The survey included questions on participants' surface-acting emotional labor (masking one's feelings at work), depressive symptoms, sleep duration and disturbances, and socio-demographics.
Results: Nearly a quarter (21.7%) of the participants reported depressive symptoms, over a half (53.6%) reported short sleep duration (≤6 hours per day), and nearly one third (32.2%) reported sleep disturbances. There was a significant association between emotional labor and depressive symptoms (β=0.82, $p<0.001$) among these workers. Sleep disturbances, not short sleep duration, partially mediated this association by 17%. Both sleep disturbances and short sleep duration did not modify this association.
Conclusion: Depressive symptoms were prevalent among healthcare workers and were associated with emotional masking. Sleep disturbances play an important intermediate role in translating emotional labor to depressive symptoms in these workers. Effective workplace programs are needed to reduce healthcare workers' emotional labor in order to improve their mental health. Sleep promotion should be emphasized to mitigate the negative effect of emotional labor and promote healthcare workers' mental wellbeing.

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HEART RATE AND HEART RATE VARIABILITY DURING SLEEP AS BIOMARKERS FOR DEPRESSION.

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Introduction: Evidence suggests a high prevalence of depression in subjects with Sleep-Wake Disorders, with impaired sleep being both a risk factor and a symptom of depression. However, depression currently remains for the most undiagnosed in this population, which can lead to a lack or delay in the treatment, and ultimately contribute to chronicity, recurrence of depression, and increase risk of suicide. Depression is characterized by alteration in sleep architecture and imbalanced autonomic nervous system function, and specific alteration may serve as biomarkers to identify ongoing depression in subjects with Sleep-Wake Disorders undergoing polysomnography. Thus, the aim of this study is to investigate differences in sleep architecture and autonomic modulation, measured by heart rate and heart rate variability throughout sleep stages, in subjects undergoing polysomnography in a sleep clinic.
Methods: A preliminary sample of forty subjects undergoing polysomnography was recruited in three different sleep clinics. The Patient Health Questionnaire–9 was administered to participants before the beginning of the sleep study. A cut-off of 10 was applied to identify subjects with possible current depression. The polysomnography recordings were processed with the MEBsleep software (Medibio Limited) which automatically calculats sleep architecture indices, and heart rate and heart rate variability parameters throughout sleep stages. The Mann-Whitney U test was used to investigate differences between the depressed and non-depressed groups.
Results: Possible current depression was found in fourteen subjects (35%). These Subjects had statistically significant higher heart rate (median depressed=78.01, median non-depressed=64.61, p=0.01) and lower Root Mean Square of the Successive Difference (RMSSD; median depressed=18.41 ms, median non-depressed=26.52 ms, p=0.02), number of pairs of successive NN intervals that differ by more than 50 ms (pNN50. Median depressed=1.62%; median non-depressed=5.64%; p=0.03), and High Frequency (absolute power) in REM (median depressed=104.17 ms2; median non-depressed=214.58 ms2; p=0.03) than those without depression. No significant differences resulted in the sleep architecture indices.
Conclusion: These results preliminary indicates a decreased parasympathetic activity in subjects with possible depression during REM, suggesting that heart rate and heart rate variability during sleep may be used as biomarkers to identify current depression in subjects undergoing polysomnography in sleep clinics.
Support (if any):

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ASSOCIATIONS BETWEEN SLEEP NEUROPHYSIOLOGY AND PERSONALITY FUNCTIONING SUPPORT DIMENSIONALITY IN MENTAL HEALTH

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Introduction: Most psychiatric disorders in adolescence are linked to alterations in sleep behavior and neurophysiology. Similar but less pronounced changes to sleep have been reported in healthy adolescent and sub-clinical samples, suggesting that the association between sleep and mental health may lie on a continuum. The current study takes a dimensional approach to better understand the link between personality functioning as assessed using the alternative DSM-5 approach to assess personality (AMPD) and brain activity measured with the sleep electroencephalogram (EEG).
Methods: The current study included 26 medication free participants (10 with Major Depressive Disorder (MDD) and 16 healthy controls; aged 14 to 17 years (mean = 15.2 (±1.1); 14 girls) recruited as part of a longitudinal study on sleep and depression. All night high-density (58 channel) sleep EEG recordings were conducted and power in the delta (0.6 to 4.6 Hz) and sigma (11 to 16 Hz) bands, corresponding to slow waves and sleep spindles respectively, was computed. Dimensions of personality were assessed using the PID-5, which consists of the five trait domains: detachment, psychoticism, antagonism, disinhibition, and negative affect. Stepwise regression analysis was performed to examine the association between PID-5 dimension and delta and sigma power. The Benjamini-Hochberg procedure was used to correct for multiple comparisons.
Results: Greater negative affect was associated with diminished delta power for 28 electrodes over frontal, temporal, central and parietal regions ($0.03 < p < 0.04$). No associations between sigma power and any of the PID-5 dimensions were found.
Conclusion: In a sample of adolescents with and without depression, we find associations between negative affect and delta power independent of other dimensions of personality functioning. Using a dimensional approach, our findings are in line with previous literature showing diminished delta power in those with MDD compared to healthy controls. Our findings provide neurophysiological support for the notion that personality functioning in youth is accurately conceptualized on a continuum.
Support (if any): This research was supported by the Interfaculty Research Cooperation Grant "Decoding Sleep: From Neurons to Health and Mind" from the University of Bern and the Swiss National Science Foundation Grant 32003B_184943 (to L.T.).

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THE ROLE OF CIRCADIAN ACTIVITY RHYTHMS IN DEPRESSIVE SYMPTOMS AMONG FEMALE NURSING STUDENTS

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Introduction: Depression is prevalent among nursing students. Rumination and sleep-wake rhythms are associated to mental illness; however, no clear path has been found. This exploratory study aimed to examine the associations among circadian activity rhythms (CAR), rumination, and depressive symptoms in female nursing students; further, to test a hypothesized CAR conceptual model.
Methods: A total of 148 female nursing junior students in China completed a battery of questionnaires, including Athens Insomnia Scale (AIS), Ruminative Responses Scale (RRS), and Self-rating Depression Scale (SDS). Wrist actigraphy was used to collect total sleep time,

CAR, and acrophase (time of the peak of the fitted activity curve). The path analysis was explored by using SPSS and AMOS.
Results: The mean age of the students was 20.64 years (SD = 0.86). About 58.8% of the participants were either mild or moderate depressed. About 93.9% of the students reported significant insomnia symptoms (AIS scores >6). Rumination was measured by the RRS (M= 2.01, SD = 0.54), and students scored higher in brooding than that of reflective pondering (2.07 vs. 1.95). The average of TST was 394.59 minutes (SD = 51.92). The CAR ranged from 0.40 to 0.98, with a mean of 0.75 (SD = 0.11). The acrophase ranged from 12:46 to 20:14 (median 16:30), with a later acrophase indicates of a more delayed circadian phase. The final model shows satisfactory fit ($\chi 2$= 2.238, p= .327); a better CAR can indirectly reduce depressive symptoms by directly reducing brooding (B = -1.149) and improving insomnia symptoms (B = -6.6443).
Conclusion: In order to prevent psychological problems of nursing students, ruminating and CAR should be part of health screening. The novel conceptual model provides a basis for reforming nursing education to prevent psychological problems.
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INSOMNIA AND DEPRESSION SYMPTOMS IN PRIMARY CARE PATIENTS REFERRED FOR MENTAL HEALTH CARE

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Introduction: Past epidemiological research indicates that insomnia and depression are both highly prevalent and tend to co-occur in the general population. The present study further assesses this association by estimating: (1) the concurrence rates of insomnia and depression in outpatients referred by their primary care providers for mental health care; and (2) whether the association between depression and insomnia varies by insomnia subtype (initial, middle, and late).
Methods: Data were collected from 3,174 patients (mean age=42.7; 74% women; 50% Black) who were referred to the integrated care program for assessment of mental health symptoms (2018–2020). All patients completed an Insomnia Severity Index (ISI) and a Patient Health Questionnaire (PHQ-9) during their evaluations. Total scores for the ISI and PHQ-9 were computed. These scores were used to categorize patients into diagnostic groups for insomnia (no-insomnia [ISI < 8], subthreshold-insomnia [ISI 8–14], and clinically-significant-insomnia [ISI>14]) and depression (no-depression [PHQ-914]). Items 1–3 of the ISI were also used to assess the association between depression and subtypes of insomnia.
Results: Rates of insomnia were as follows: 34.6% for subthreshold-insomnia, 35.5% for clinically-significant insomnia, and 28.9% for mild-depression and 26.9% for clinically-significant-depression. 92% of patients with clinically significant depression reported at least subthreshold levels of insomnia. While the majority of patients with clinical depression reported having insomnia, the proportion of patients that endorsed these symptoms were comparable across insomnia subtypes (percent by subtype: initial insomnia 63%; middle insomnia 61%; late insomnia 59%).
Conclusion: According to these data, the proportion of outpatients referred for mental health evaluations that endorse treatable levels of insomnia is very high (approximately 70%). This naturally gives rise to at least two questions: how will such symptomatology be addressed (within primary or specialty care) and what affect might targeted treatment for insomnia have on health were it a focus of treatment in general?
Support (if any): Vargas: K23HL141581; Perlis: K24AG055602

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A NOVEL MODULARIZED INTERVENTION TO IMPROVE SLEEP IN OLDER HOSPITALIZED VETERANS

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Introduction: Disturbed sleep in hospitalized patient populations is a highly prevalent phenomenon, with patients commonly reporting problems with shorter sleep duration, more frequent awakenings, and overall poorer sleep quality during hospital stay compared to at home. Sleep disturbance during hospitalization is especially problematic as sleep is associated with both physical and psychological well-being. Poorer sleep has been found to impact recovery outcomes in a number of patient populations including mild traumatic brain injury, chronic pain, and most recently, in hospitalized COVID-19 patients. The current analyses examined pilot data from a novel brief modularized sleep intervention implemented with older adult Veterans living on a subacute rehabilitation unit.
Methods: Participants were screened for sleep problems upon admission to the unit. Veterans who screened positive were invited to participate in the sleep intervention. Components of the intervention were selected based on screener responses and included group sleep hygiene psychoeducation, environmental accommodations (e.g. ear plugs, eye mask, soothing music), and CPAP use education. Measures completed at pre- and post- intervention assessed sleep quality (Pittsburgh Sleep Quality Index, PSQI), global health functioning (PROMIS Global Health Scale), and depressive symptoms (Patient Health Questionnaire, PHQ-9). Pre- and post- scores were compared using paired sample t-tests. Two samples t-tests compared change scores in PHQ-9 between groups.
Results: A total of 33 Veterans were included in the analyses (Mage = 69.6, 3 female, intervention group n = 21). Participants showed a trend toward decreased PHQ-9 scores following the intervention (t(16) = 1.58, p = 0.100). There were no significant effects of the intervention on sleep quality or global health. Compared to the non-intervention group, the intervention group showed greater decrease in PHQ-9 scores at the time of post-intervention (t(25) = .828, p = .025).
Conclusion: Preliminary data suggests that a brief modularized sleep intervention may benefit depressive symptoms for older adults during hospitalization. Additional research is needed to better understand the impact of a brief intervention on self-reported sleep quality during the hospitalization period.
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THE MODERATING INFLUENCE OF DEPRESSION ON INSOMNIA AND SUICIDAL IDEATION IN A MILITARY SAMPLE

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Introduction: Military personnel are at an increased risk for suicide compared to the general population, making it important to develop a deeper understanding of which factors contribute to this elevated risk. Given that suicidal ideation (SI) is one of the strongest predictors of suicide attempts, understanding factors that underlie SI may improve prevention efforts. Insomnia and depression both serve as independent risk factors for SI, and therefore the aim of this study was to examine the extent to which depressive symptoms moderate the association between insomnia and SI.
Methods: Data were obtained from the All Army Study of the Army Study to Assess Risk and Resilience in Servicemembers (STARRS). Soldiers (n=21,450) completed questions related to suicidal ideation (5 items), depressive symptoms (9 items), and insomnia (5 items) based on symptom presence in the past 30 days. Items in each domain were summed to create a total severity score. GEE models using a negative binomial linking function were conducted to examine the impact of depression, insomnia, and their interaction on SI.
Results: Both depression ($\chi2$ =117.56, p<0.001) and insomnia ($\chi2$=11.79, p=0.0006) were found to have significant main effects on SI, and there was a significant interaction effect ($\chi2$=4.52, p=0.0335). Follow up simple effects revealed that insomnia was no longer significantly associated with SI when depression severity was low, but was associated with SI in the presence of greater depression severity ($\chi2$=2.91, p=0.0882).
Conclusion: In a large sample of Army soldiers, depression significantly moderated the association between SI and insomnia, such that insomnia seems to amplify the effects of depression on SI. These findings highlight the importance of addressing insomnia severity as a mean of reducing SI in those with depression, potentially allowing for intervention prior to a suicide attempt.
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ASSOCIATIONS BETWEEN SLEEP COMPLAINTS, SUICIDAL IDEATION AND DEPRESSION AMONG ADOLESCENTS AND YOUNG ADULTS IN GREECE

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Introduction: Suicide risk begins to increase among adolescents and young adults representing the leading cause of death in this age group. The aim of this study was to assess associations between sleep complaints, suicidal ideation and depression in a large, representative sample of adolescents and young adults of the general population in Greece.
Methods: A structured telephone questionnaire was conducted in a representative sample of 2.741 young Greeks aged 15–24 years, including sociodemographic variables, life-style habits, and substance use. symptoms were assessed using the PhQ-9. Suicidal ideation and sleep complaints, i.e. insomnia/ hypersomnia symptoms, were assessed based on the relevant questions of the PhQ-9 questionnaire. We conducted a direct and indirect effect analysis between the modified PhQ-7 scale, sleep complaints and suicidality controlling for gender, family income, education and substance use.
Results: In our sample prevalence of suicidal ideation was 7.8%, while 47.9% reported sleep complaints. The mean PhQ-7 score was 6.15±4.11. The direct paths from depression to sleep, as well as from sleep to ideation were both statistically significant with p-values <0.001. Indirect mediation analysis revealed a significant indirect effect of depression on ideation mediated by sleep complaints as indicated by the sobel test (z=3.59, p=0.0003). This is a partial mediation given that the direct effect of depression on ideation controlling for sleep (the mediator) remains significant (p<.001). The percentage of the effect of depression on ideation accounted for by the indirect effect through sleep is estimated at 16.5%. The mediation remains significant (p<.001) after controlling for income, gender, education, and substance use.
Conclusion: Our study supports that among youth there is direct associations between depression, sleep complaints and suicidal ideation. Furthermore, we found an indirect effect of depression on suicidal ideation mediated by sleep complaints. Our findings highlight the presence of complex interactions between subjective psychiatric symptoms and perceived sleep problems to account for suicidal ideation Therefore, treatment of sleep among youth with depression may significantly independently further reduce suicidal risk.
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CIRCADIAN REST-ACTIVITY SIGNATURES IN WOMEN WITH MAJOR DEPRESSIVE DISORDER

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Introduction: Patients with major depressive disorder (MDD) show disrupted circadian rhythms and sleep, including reduced daytime physical activity and poor sleep quality. However, previous findings are masked by psychotropic medication intake, co-morbid diseases and years of chronic mental illness. Here, we aim at identifying circadian motor activity patterns in unmedicated women at the onset of MDD.
Methods: Twelve young unmedicated women with MDD (Mean+-SD: 24.9+-5.2y; range: 18-33y) and eight age-matched healthy women (Mean+-SD: 24.5+-3.2y; range: 20-31y) participated in our study. Activity recordings were collected using wrist-worn wearable devices (actigraphs) for ~7 days in real-life settings. Cosinor analyses were performed to assess the amplitude and phase of the 24-h rest-activity activity rhythms. Non-parametric analyses were used to quantify interdaily stability and intradaily variability of the rest-activity rhythm. Furthermore, we calculated the mean activity level and scaling exponent alpha, which quantifies the temporal correlation in activity fluctuations, per 3-h bins across the 24-h sleep-wake cycle.
Results: Women with MDD showed a significantly higher amplitude of the 24-h rest-activity activity rhythm (Mean+-SD: 332.7+-120.8 arbitrary units) than the controls (179.7+-122.9; p=0.002), elicited by higher activity levels during the daytime (0-12h after habitual wake-up time; p<0.01). In contrast, women with MDD showed a trend for lower interdaily stability levels than controls (respectively, 0.41+-0.07 and 0.46+-0.08; p=0.05). Interestingly, a significant interaction effect of "group" and "time since habitual wake" was elicited for scaling exponent alpha (p<0.001). Accordingly, women with MDD had higher

alpha values during habitual sleep (0–6 hours before habitual wake-up time) than controls (respectively, 1.18+-0.22 and 1.12+-0.22).
Conclusion: Unmedicated women at the onset of MDD had altered circadian motor activity patterns, as indexed by higher amplitude particularly during daytime while awake, less stable 24-h activity rhythms, and highly correlated activity patterns during sleep that closely resemble those typically occurring during wakefulness. These findings suggest that MDD per se may be associated with impaired rest-activity profiles. Ultimately, the use of wearable devices might hold important prospects for the early detection of individuals at risk for mood disorders.
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SLEEP AND MENTAL HEALTH IN NEW MOTHERS WITH A HISTORY OF DEPRESSION: PRELIMINARY DATA FROM LATE PREGNANCY TO 1-MONTH POSTPARTUM

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Introduction: Perinatal women report more sleep disruptions than non-pregnant women. This phenomenon is exaggerated among women with a history of depression, as sleep complaints are one of the most frequent symptoms of depression. Understanding the change in sleep and mental health from late pregnancy to postpartum may provide insights into prevention and intervention. Presented here are preliminary data from new mothers regarding sleep and mental health.
Methods: Preliminary examination of sleep and psychological data from 22 women enrolled in a study to assess the efficacy of the SNOO on infant and maternal sleep during the first 6 months of life. Participants were eligible if they had a history of, but no active depression as assessed by the Edinburgh Postnatal Depression Scale (EPDS). Data are from late pregnancy and at 1-month postpartum. Questionnaires included the Pittsburgh Sleep Quality Index (PSQI), Insomnia Symptom Questionnaire (ISQ), Epworth Sleepiness Scale (ESS), Flinders Fatigue Scale (FFS), and the Generalized Anxiety Disorder scale (GAD). Paired t-tests or chi-square tests were used to assess change over the first month postpartum. Linear regressions were done to determine whether sleep in late pregnancy was associated with depression and anxiety scores.
Results: Participants were 30 ± 2.2 years of age and 72.7% were White. In the first month postpartum, sleep was negatively impacted. Clinical insomnia increased (4 (18.2%) vs 5 (22.7%); X2 = 7.61, p = .006), sleep quality (PSQI) worsened (6.13 ± 3.54 vs 8.89 ± 3.54; t = -3.03, p =n .006), daytime sleepiness was higher (4.77 ± 2.51 vs 6.64 ±3.44; t = -3.31, p = .003), and fatigue was greater (9.55 ± 4.73 vs 13.36 ± 5.86; t = -3.21, p = .004). Likewise, depression and generalized anxiety increased (p's < .01). Insomnia in late pregnancy was associated with more depression (β = .542, p = .009) and more anxiety (β = .510, p = .015).
Conclusion: Pregnant women with a history of depression are at risk for more sleep disturbances, and therefore more likely to be at significant risk for a recurrent depressive episode. Improving sleep in the perinatal period could have a positive impact.
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DOES OBSTRUCTIVE SLEEP APNEA INCREASE SUICIDALITY IN PATIENTS WITH BIPOLAR DISORDER?

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Introduction: Bipolar disorder (BPD) is associated with suicidality in adult population. There are several risk factors for suicide, however the relationship between Obstructive Sleep Apnea (OSA) and suicidality in patients with BPD has not been explored. Hence, we decided to perform this study with primary objective of comparison of suicidality by OSA diagnosis in patients with BPD.
Methods: We used inpatient hospitalization data from National Inpatient sample dataset year 2016–2018. Our primary population (BPD + OSA) was composed of adult patients admitted to the hospital with the primary diagnosis of Bipolar Disorder and secondary diagnosis of Obstructive sleep apnea. Age-gender matched (1:4 matching) control population was selected with primary diagnosis of BPD having no OSA (BPD-OSA). Data on suicidality (suicidal ideation/attempt) were collected and compared between the groups using logistic regression analysis methods by including OSA, age, gender, race, substance use disorder and personality disorder as predictors.
Results: From the dataset, 17895 patients were obtained for the BPD + OSA group (average age: 50.5 years, male 45.5%). After 1:4 age-gender matching, 71575 patients were included in the BPD-OSA group. In the unadjusted analysis, suicidal ideation was significantly high BPD+OSA group compared the BPD-OSA group (38.4% vs. 31.9%, $p < 0.001$). Rate of suicide attempt and self-inflicted injuries were similar in two groups (3.5% vs. 3.3%, p: 0.27). In the adjusted logistic regression analysis odds of suicidality were 36% more in BPD+OSA group compared to BPD-OSA (Odds Ratio: 1.36, 95% Confidence interval: 1.25–1.48, $p < 0.001$).
Conclusion: In adult patients with BPD, diagnosis of OSA significantly increases the odds of suicidality. Addressing OSA in patients with BPD, can improve management, and potentially reduce the incidence of suicide. We believe our study will be helpful in guiding future research and development on this issue.
Support (if any): None

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ASSOCIATIONS BETWEEN DEPRESSION AND GUIDELINES MET FOR PHYSICAL ACTIVITY AND SUFFICIENT SLEEP IN AN INTERNATIONAL SAMPLE

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Introduction: Physical activity (PA) and sleep both influence symptoms of depression. Here we explored relationships between guidelines met for physical activity and sleep and how this related to depression scores.
Methods: N=23,663 respondents (age range 18–98, mean age 40.1y, 51% female) completed the 10-item Harvard Department of Psychiatry National Depression Screening Day Scale (HANDS) online during one week in October from 2018–2020. Higher total scores on the HANDS indicated a higher likelihood of major depressive episode. Additional questions were added to the survey including questions on sleep duration and moderate to strenuous PA. The cut-off guidelines for PA were 150 weekly minutes and 7-9h of sleep per night. We categorized the sample based on those who met PA guidelines or not and whether respondents had short sleep duration (9h), or met the sleep guidelines (7-9h).
Results: One-way ANOVA revealed differences between the groups on HANDS depression score $F(5,23657)=262.5$, $p<0.001$. Nearly half of the sample did not meet both PA guidelines or sleep guidelines of

7-9h (N=10,776; 45.5%). The lowest depression scores were associated with those who met both PA and sleep guidelines (8.3 depression score) compared to those with the highest scores who exceeded sleep recommendations (>9h) and did not meet PA guidelines (14.1 depression score). In addition, met sleep guidelines (10.0) appeared to have a bigger influence than met PA guidelines (11.1) in the absence of the other guideline being met on depression score.
Conclusion: We found those who met both sleep and PA guidelines had the lowest depression scores with those who exceeded the sleep guidelines and did not meet PA recommendations had the highest depression scores. Future research on depression could focus on interventions aimed at improving adherence to both PA and sleep guidelines.
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BEDTIME PROCRASTINATION BUT NOT TOTAL SLEEP TIME MEDIATES THE ASSOCIATION BETWEEN ANXIETY AND SLEEP PROBLEMS

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Introduction: There is a high rate of sleep disorders and anxiety in primary care settings and patients are most likely to report such issues to their primary care provider. This study assessed whether total sleep time and bedtime procrastination mediated the association between anxiety and sleep problems when covarying for age and attitudes about sleep.
Methods: 308 adult primary care patients seen at either a university integrated primary care clinic (n = 147; 47.7%) or federally qualified health center (n = 161; 52.3%) from August 2019 to March 2020 completed intake paperwork including questions assessing psychiatric symptoms and sleep.
Results: A structural equation model was used. To test for statistical mediation, we performed 500 bootstraps and examined bias-corrected estimates. The model evidenced good fit, X2 (16) = 22.53, p = .127, CFI = .98, TLI = .95, SRMR = .03, RMSEA = .04 [90% CI: .00, .07]. All manifest variables loaded significantly onto their latent factors (standardized loadings > .40, p values < .05). The model explained 14.7% of the variance in total sleep time (TST), 14.8% in sleep procrastination, and 54.0% in sleep problems. Anxiety was negatively associated with TST (β = -.36, p < .001) and positively associated with bedtime procrastination (β = .35, p < .001) and greater sleep problems (β = .63, p = .006). The association between anxiety and sleep problems was not statistically mediated by TST. There was a significant indirect effect of anxiety on sleep problems through bedtime procrastination. The total effect of anxiety on sleep problems was significant (β = .70, p = .003). We found a significant direct association between age and TST, and age and bedtime procrastination. However, there was no significant direct association between age and sleep problems (β = .00, p = .984). Sleep attitudes were unrelated to any of the primary study variables. None of the exogenous variable covariances were significant. The covariance between TST and bedtime procrastination was significant.
Conclusion: Sleep problems are pervasive and complex. This study highlights factors related to sleep problems and support anxiety and pre-bedtime behaviors as treatment targets.
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INDICATORS OF DELAYED CIRCADIAN RHYTHMS ARE ASSOCIATED WITH OCD SYMPTOMS

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Introduction: Increasing evidence implicates delayed circadian rhythms in obsessive-compulsive disorder (OCD). Indeed, eveningness prospectively predicts increased OCD symptoms (Cox, Tuck, & Olatunji, 2018), and several studies have highlighted a link between later bedtimes and OCD symptoms (e.g., Nota et al., 2020; Schubert, Stewart, & Coles, 2019). Notably, no study to date has examined the associations between midsleep or delayed sleep-wake phase disorder (DSWPD) status and OCD symptom severity. The present study sought to address these gaps in the literature by utilizing a multimethod approach to characterize the associations between indicators of delayed circadian rhythms and OCD.
Methods: Adults with (n=57) and without (n=20) elevated OCD symptoms were recruited. Of those with elevated symptoms, 20 met criteria for OCD. Of those who did not meet criteria for OCD, 29 were identified as healthy controls (no diagnoses). On day 1, participants were administered the MINI International Neuropsychiatric Interview (Sheehan et al., 1988) to determine diagnostic status, the Diagnostic Interview for Sleep Patterns and Disorders (Merikangas et al., 2014) to diagnose DSWPD, and the Morningness-Eveningness Questionnaire (Horne & Ostberg, 1976) to measure eveningness tendency. Participants then completed 7 days of sleep monitoring with the Consensus Sleep Diary (CSD; Carney et al., 2012) to measure midsleep. On day 9, participants completed the Obsessive-Compulsive Inventory-Revised (Foa et al., 2002) to measure OCD symptom severity.
Results: Results indicated a significant relationship between OCD and DSWPD status, X2(2, n=49)=13.91, p<.01, such that 40% of those with OCD also met criteria for DSWPD, relative to 0% of healthy controls. Similarly, those with OCD reported significantly increased eveningness tendency (M=40.60, SD=9.54) compared to healthy controls (M=53.66, SD=13.15), t(47)=3.80, p<.01, d=1.14. Among those with elevated OCD symptoms, there was trend level increase in OCD symptom severity between those with DSWPD (M=25.45, SD=11.23) and without DSWPD (M=19.44, SD=9.80), t(52)=1.76, p=.08, d=0.57. Finally, across the whole sample, later midsleep significantly predicted increased OCD symptoms (b=.27, p<.05).
Conclusion: These results replicate and extend the growing literature on delayed circadian rhythms in OCD and suggest that circadian dysregulation may represent a novel target for treatment.
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NEURAL ACTIVATION ACCOMPANYING FEAR CONDITIONING AND EXTINCTION IN GENERALIZED ANXIETY DISORDER WITH AND WITHOUT INSOMNIA DISORDER

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Introduction: We examined associations of sleep quality with neural responses to fear conditioning and extinction in individuals with Generalized Anxiety Disorder (GAD) with (INS) and without (NOI) Insomnia Disorder (ID). We hypothesized fear-related regions would show greater, and emotion-regulatory regions lesser activity in INS versus NOI and across both groups with decreasing sleep quality.
Methods: Participants were assigned to either an INS group with Insomnia Severity Index (ISI) ≥ 13 (N=21) or NOI with ISI ≤ 12 (N=14). Two weeks of actigraphy and sleep diaries were followed by a 2-session protocol with fMRI. During Session 1, mild electric shock produced conditioned fear to 2 different colors (CS+s) but not a third (CS-) (Fear Conditioning). Immediately afterward, one CS+ (CS+E) but not the other (CS+U) was extinguished (Extinction Learning). All 3 stimuli were presented 24h later (Extinction Recall). An acclimation/

diagnostic ambulatory polysomnography (PSG) night was followed by PSGs before Session 1 and between Sessions 1 and 2. Using SPM8, t-tests compared groups, and multiple regressions predicted anterior cerebral activations (as a whole and as ROIs) using ISI, actigraph and diary sleep efficiency (SE) and latency (SOL), and sleep architecture.
Results: Beginning Fear Conditioning, differential activation to the reinforced stimulus (CS+>CS-) in the right insula was greater in INS than NOI, and greater actigraph SE predicted greater prefrontal activation. Change in activation to the CS+ across Extinction Learning (late CS+>early CS+) did not differentiate groups or correlate with sleep measures. During Extinction Recall, NOI versus INS showed less activation in bilateral amygdala ROIs (CS+E>CS-) but more activation in prefrontal regulatory regions (CS+U>CS-) and bilateral insula ROIs (both contrasts). Greater activation of prefrontal emotion-regulatory areas was associated with greater REM% (CS+E>CS+U and CS+E>CS-), lesser ISI (CS+E>CS- and CS+U>CS-), and greater actigraph SE (CS+U>CS). However for CS+E>CS+U, lesser diary SE and greater ISI were associated with greater prefrontal activity.
Conclusion: Results, on balance, suggest that persons with GAD and ID activated more fear-related and less prefrontal emotion-regulatory regions during fear conditioning and extinction recall than those with GAD alone. Across groups, greater REM% and sleep quality were associated with greater activity of emotion-regulatory areas.
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ANXIETY AND SLEEP IN GENERALIZED ANXIETY DISORDER WITH AND WITHOUT INSOMNIA DISORDER

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Introduction: Insomnia Disorder (ID) elevates risk of incident anxiety disorders and vice versa. We examined whether ID and poor sleep are associated with greater self-reported anxiety in persons with Generalized Anxiety Disorder (GAD).
Methods: Twenty-one participants with GAD and ID (GAD+/ID+) having Insomnia Severity Index (ISI) scores ≥ 13 (mean 17.8, SD 3.6) and 14 with GAD but not ID (GAD+/ID-) having ISI scores ≤ 12 (mean 6.4, SD 3.4) completed 14 days of actigraphy and sleep diaries as well as a night of ambulatory polysomnography (PSG) following an acclimation night. Participants completed the Pittsburgh Sleep Quality Index (PSQI), the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA-T/C, -T/S), the Ford Insomnia Response to Stress Test (FIRST), the Penn State Worry Questionnaire (PSWQ), and the Anxiety Sensitivity Index (ASI). Differences in self-reported anxiety (STICSA, ASI, PSWQ) between GAD+/ID+ and GAD+/ID- were analyzed using t-tests. Relationships of anxiety with retrospective (PSQI, FIRST, ISI), longitudinal (actigraphy, diaries) and physiological (PSG) sleep variables were analyzed using simple regression.
Results: GAD+/ID+ versus GAD+/ID- participants showed trends toward higher anxiety on the PSWQ (p=0.075), ASI (p=0.072) and STICSA-T/S (p=0.078). PSQI scores were positively associated with STICSA-T/S, (R=0.417, p=0.018, N=32). Greater insomnia reactivity (FIRST) was associated with increased worry on the PSWQ (R=0.352, p=0.044, N=33). STICSA-T/C was negatively associated with mean diary (R= -0.440, p=0.015, N=30) and actigraph (R= -0.517, p=0.01, N=24) total sleep time (TST). Actigraph mean TST trended toward lower PSWQ (R= -0.376, p=0.058, N=26) while actigraph mean sleep efficiency (SE) trended toward lesser STICSA-T/C (R= -0.397, p=0.058). Greater REM% was associated with greater STICSA-T/C (R=0.613, p=0.0005, N=28) and STICSA-T/S (R=0.516, p=0.005), a relationship also seen in GAD+/ID+ alone (p=0.03 and 0.015 respectively, N=16). Slow Wave Sleep% (SWS%) was not associated with lesser STICSA-T/S across both groups (p=0.14) but was so in GAD+/ID+ (R= -0.539, p=0.031, N=16).
Conclusion: GAD+/ID+ versus GAD+/ID-, show greater worry, anxiety sensitivity and somatic anxiety. In GAD, shorter and poorer quality sleep measured retrospectively or averaged longitudinally, as well as greater REM%, are associated with greater somatic and cognitive anxiety. Among those with ID, greater SWS% is associated with less somatic anxiety.
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ANXIETY IS A POTENTIAL MEDIATING FACTOR IN THE INSOMNIA-AGGRESSION ASSOCIATION

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Introduction: Several recent studies have found an association between insomnia and increased aggression. Aggression may increase arousal, thereby predisposing individuals to sleep difficulties. Conversely, insomnia may impair brain circuitry involved in aggression. Ultimately, the relationship between insomnia and aggression remains poorly understood and understudied. This study sought to explore this association in a sample of individuals with a wide range of insomnia symptom severity, stratified from minimal to moderately severe.
Methods: Participants' (N=66) insomnia symptoms were assessed using the Insomnia Severity Index. Participants also completed daily sleep diaries for 7–21 days followed by an ambulatory polysomnography overnight sleep study to characterize participants' sleep and to rule out organic sleep disorders. The evening of the overnight sleep study, participants completed the 34-item Buss-Perry Aggression Questionnaire (AQ). Pearson's correlation coefficient was used to assess associations between insomnia, AQ total score, and the AQ subscale scores (i.e., physical aggression, verbal aggression, anger, hostility, indirect aggression). Multiple regression was utilized to determine whether aggression was associated with insomnia severity while adjusting for demographic features, depression symptoms (Patient Health Questionnaire-9) and trait anxiety (State-Trait Anxiety inventory).
Results: In bivariate analyses, insomnia severity was significantly correlated with the AQ total score and with the anger and hostility subscales of the AQ (r=0.297, p<0.05; r=0.266, p<0.05; r=0.321, p<0.05 respectively). When adjusting for the significant association between anxiety and insomnia in multiple regression analyses, anger and hostility were no longer significantly associated with insomnia severity(p>.05).
Conclusion: Our investigation suggests that the association between insomnia and aggression is most specific to anger and hostility but that these associations may be better explained by their shared associations with anxiety.
Support (if any):

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SLEEP ARCHITECTURE AND SLEEP PROBLEMS IN ADOLESCENTS AND YOUNG ADULTS WITH AND WITHOUT ADHD: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: During the past years, an increasing number of articles has focused on comparing sleep in youths with and without ADHD. However, so far no meta-analysis has been conducted summarizing the findings. Therefore, the current study assesses sleep architecture (i.e. the basic sleep structure), sleep problems, and sleep hygiene. Sleep was assessed both subjectively and objectively and the two groups were compared on multiple variables.
Methods: Two researchers independently performed a literature search (1980–2020). Studies using a case-control design comparing sleep in youths (12–25 years) with and without ADHD were included. Study quality was evaluated using the Newcastle-Ottawa Scale. Standardized mean differences were calculated for each outcome domain being reported by at least two studies.
Results: 10379 publications were screened, resulting in 11 studies and 52 effect sizes (nADHD=2377, ncontrol=21687). These effect sizes were summarized into 7 objective and 11 subjective variables measuring sleep. Two objective sleep variables were significantly worse in the ADHD group; total sleep time (z=2.16, p=.03) and sleep onset latency (z=2.39, p=.02). The two groups did not differ on sleep efficiency, sleep onset/offset time, and time in bed. Comparing the groups on subjective variables resulted in the same pattern, with total sleep time (z=21.27, p<.001) being significantly shorter in the ADHD group, and sleep onset latency (z=15.39, p<.001) and wake after sleep onset (z=13.50, p<.001) being significantly longer. Additionally, the ADHD group reported a significantly lower sleep efficiency (z=20.15, p<.001) and subjective sleep satisfaction (z=3.50, p<.001). Wake time and number of awakenings during the night were not significant. Youths with ADHD also reported significantly more sleep problems, including insomnia (z=6.38, p<.001), daytime sleepiness (z=26.68, p<.001) and sleep disturbances (z=8.00, p<.001). Due to only two studies measuring it, with a focus on different variables, sleep hygiene could not be included.
Conclusion: In general, youths with ADHD have a disrupted sleep architecture and experience more sleep problems compared to their typically developing peers. Consequently, sleep assessment should become a routine part during the diagnostic process of ADHD. Additionally, more research is needed focusing on sleep architecture and sleep hygiene, and on the development of a sleep intervention for youths with ADHD.
Support (if any):

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THE RELATIONSHIP BETWEEN CIRCADIAN RHYTHM AND AUTISM SPECTRUM DISORDER TRAITS AND EXECUTIVE FUNCTION ACROSS THE LIFE SPAN

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Introduction: Children and adults with autism spectrum disorder (ASD) often have sleep, circadian, and executive function impairments, which can affect daytime quality. Yet, the relationship between sleep or circadian traits and ASD traits is still unknown. Thus, we aimed to determine if sleep and circadian traits were associated with ASD traits, including executive function.
Methods: We studied data from participants with and without ASD enrolled in the family-based study Autism Spectrum Program of Excellence (ASPE), University of Pennsylvania. We used GGIR to analyze actigraphy-derived sleep and circadian traits from 250 participants (219 adults ages 18–87 years, mean 44.2 ± 17.3 years; 31 children ages 4–17 years, mean 11.3 ± 3.9 years). These traits were compared to ASD traits (social impairment and restricted/repetitive behavior via Social Responsiveness Scale, Second Edition) and executive function (Behavior Rating Inventory of Executive Function) using linear multivariate regression models adjusted for age, age2, and sex via Sequential Oligogenic Linkage Analysis Routines.
Results: In adults, earlier start time of the 10 hours of highest activity in a 24-hour day (M10 start time; p = 0.02), decreased robustness of the rest/activity rhythm (relative amplitude; p = 0.03), and increased intradaily variability of rest/activity rhythm (p = 0.04) were associated with more social impairment. In children, earlier M10 start time (p = 0.02) and decreased relative amplitude (p = 0.03) were associated with more social impairment. In adults, higher average 5-hour period of lowest activity in a 24-hour day (L5 average; p = 0.03), lower average 10-hour period of highest activity in a 24-hour day (M10 average; p = 0.005), earlier M10 start time (p = 0.02), decreased relative amplitude (p = <0.001), increased intradaily variability (p = <0.001) and decreased sleep efficiency (p = 0.04) were associated with increased executive function impairment. In children, earlier M10 start time (p = 0.006) and intradailty variability (p = 0.008) were associated with increased executive function impairment.
Conclusion: Circadian traits are significantly associated with ASD traits, including executive function, suggesting the importance of sleep-wake rhythm dysfunction in ASD.
Support (if any): Anonymous donor; NIH T32HL07713; University of Pennsylvania's Institute for Translational Medicine and Therapeutics

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IS ALCOHOL CRAVING ASSOCIATED WITH INSOMNIA IN PATIENTS WITH COMORBID INSOMNIA AND ALCOHOL USE DISORDER?

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Introduction: A preliminary study showed the existence of a relationship between alcohol craving and insomnia symptoms. The current investigation aimed to further assess the relationship between obsessive and compulsive qualities of alcohol craving and insomnia disorder in a larger sample of subjects with Alcohol Use Disorder (AUD) seeking treatment for their drinking.
Methods: We used baseline cross-sectional data from a clinical trial of treatment-seeking patients with AUD (N=123). We used the following instruments: Insomnia Severity Index (ISI) total score for insomnia; Obsessive Compulsive Drinking Scale (OCDS) scale scores for alcohol craving; Time-Line follow Back interview for computing the number of drinks per drinking day within the past 90 days; Hamilton Anxiety Rating Scale total score for the anxiety symptoms; and Addiction Severity Index for demographic variables. We used bivariate analysis to evaluate whether alcohol craving outcome measures (OCDS subscale scores and total score) were independently associated with the ISI total score. A multivariable model adjusted for sociodemographic and clinical covariates further evaluated this relationship between OCDS and ISI total scores.
Results: The mean (SD) age was 44.02 (10.37) years with 13.29 (3.10) years of education, 83.74% were males, 41.80% identified themselves as White, 17.21% were married, and 56.09% were employed. In

a bivariate analysis, ISI total score was associated with the obsessive subscale (β=0.25, p<0.0001), compulsive drinking subscale (β=0.24, p<0.002), and OCDS total score (β=0.50, p<0.0001). The OCDS total score showed a stronger association with the insomnia symptoms (ISI items 1a-1c) (β=0.99, p<0.0001) than the manifestations of insomnia symptoms (items 2–5; β=0.83, p<0.0001). In the multivariable model adjusted for covariates, the relationship between OCDS and ISI total scores continued to remain significant (β=0.37, R2=0.18, p=0.01).
Conclusion: This study not only confirmed that alcohol craving was associated with insomnia in a larger sample but also demonstrated that insomnia is linked to both obsessive thoughts about alcohol use and compulsive drinking behavior, especially its obsessive aspect. These findings add to the growing literature on the relationship between a pathologic drive for alcohol use and abnormal wakefulness.
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DOES IMPROVING SLEEP LEAD TO BETTER MENTAL HEALTH? A META-ANALYSIS OF RANDOMISED CONTROLLED TRIALS

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Introduction: Sleep and mental health go hand-in-hand; however, the extent to which sleep is causally related to the experience of mental health difficulties is unclear. One way to test whether there is a causal link is to evaluate the extent to which interventions that improve sleep also improve mental health over time.
Methods: We conducted a systematic review and meta-analysis of 54 randomised controlled trials (N = 6,876) that reported the effects of interventions that successfully improved sleep on overall composite mental health, as well as on six specific mental health difficulties including depression, anxiety, stress, psychosis spectrum experiences, suicidal ideation, and PTSD.
Results: Improving sleep had a medium-sized effect on composite mental health (g+ = -0.47), and depression (g+ = -0.54), small-to-medium sized effects on anxiety (g+ = -0.40), and stress (g+ = -0.42), and small effects on positive psychosis spectrum experiences (g+ = -0.26). We also found a significant dose response relationship, in that greater improvements in sleep were associated with greater improvements in composite mental health.
Conclusion: Taken together, the findings suggest that sleep is causally related to the experience of mental health difficulties. Improving sleep leads to better mental health, especially for experiences of depression, anxiety, and stress. Future research might profitably consider how interventions that improve sleep be better incorporated into routine mental health care, as well as the possible mechanisms of action that might explain how sleep exerts its effects on mental health.
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SLEEP HEALTH KNOWLEDGE, ATTITUDES, BELIEFS, AND PRACTICES AMONG MOTHERS WITH A HISTORY OF PERINATAL DEPRESSION OR ANXIETY

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Introduction: Tailored interventions could optimize sleep health for mothers with a history of perinatal depression or anxiety. The purpose of this study was to describe sleep health knowledge, attitudes, beliefs, and practices among mothers who were previously treated for perinatal depression or anxiety, to inform future tailored sleep health interventions.
Methods: Mothers (N = 16) who had previously received treatment for perinatal depression or anxiety from a clinic serving low-resourced communities completed a single-occasion research home visit that included a demographics questionnaire and semi-structured interview. Interview data were analyzed using inductive content analysis, adapted from grounded theory.
Results: Mothers were, on average, 28.19 (SD = 7.71) years and had a child who was between 12 and 36 months. Of the mothers, 43.8% were White, 18.8% Black, 23.5% multiracial, 25.0% other race, 37.5% Hispanic, and 75.0% reported an annual household income of < $40,000. "Needing to focus on sleep" was the core construct that emerged from the interview data, which was comprised of three domains. The first domain, "Having pretty good sleep," described mothers' experiences of good sleep health including easily falling and staying asleep, feeling satisfied with their sleep, and feeling well-rested. The second domain, "Trying to get normal healthy sleep," described mothers' experiences of poor sleep health and its consequences for physical and mental health. The third domain, "Wondering how to get better sleep with everything going on," described everyday realities that got in the way of good sleep health including child sleep problems, competing demands on time, irregular work schedules, symptoms of depression or anxiety, and significant life transitions around school/work and pregnancy/postpartum.
Conclusion: Findings showed a range of maternal sleep health experiences. Mothers' sleep health overlapped with mental health and wellbeing, children's sleep health, and social determinants of health. Future sleep health interventions for mothers with a history of perinatal depression or anxiety could include tailored approaches that build on existing maternal strengths, integrate with existing mental health care services and child sleep health interventions, address social determinants, and attend to significant life transitions.
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EXAMINING SLEEP DIFFICULTIES AND SUICIDE IDEATION AMONG THOSE REPORTING ABUSE AND DEPENDENCE ON ILLICIT DRUGS AND ALCOHOL

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Introduction: Sleep disturbance is associated with poor mental health and may contribute to initiating or continuing use/abuse of alcohol and drugs. Using data from a nationwide survey, we examined the relationship between sleep disturbance and suicide behaviors among youth and adults, including those who report drug/alcohol use and abuse.
Methods: We analyzed data from the 2018 National Survey on Drug Use and Health (NSDUH), an annual survey collecting information about the use of illicit drugs and alcohol among non-institutionalized U.S. youth (age 12–17) and adults (age>17). The 2018 survey included 9,398 youth and 43,026 adult respondents. Depression was assessed in adults with the Kessler-6 and in youth with several questions assessing psychological distress. Those who scored at risk for psychological distress were also asked about sleep disturbance and suicidal behaviors (i.e., ideation, planning, attempt). All were asked to report their drug/

alcohol use and/or abuse. Our study population included those who reported psychological distress. We conducted binary logistic regression to examine the relationship between suicidal behavior and sleep disturbance in this population. We also conducted sub-analyses to explore the relationship between suicidal behavior and sleep disturbance among those reporting drug/alcohol use and abuse.
Results: Youth were 29% male and 71% female, adults were 36% male and 64% female. Adult participants, 39% were 18 to 25, 22% were 26 to 34, and 39% were age 35 and older. Among those with psychological distress, suicidal behavior was more likely among those who reported sleep disturbance (youth: OR=2.7, 95%CI:1.8–4.0; adults: OR=1.3, 95%CI:1.2–1.5). Also, among those with psychological distress, suicidal behavior was more likely among those who reported concomitant sleep disturbance and either alcohol abuse/alcoholism (youth: OR:3.3, 95%CI:1.6–7.0; adults: OR=1.4, 95%CI:1.1–1.7); illicit drug abuse (youth: OR=3.5, 95%CI:1.6–7.4; adults: OR=1.3, 95%CI:1.0–1.6); or alcohol and illicit drug abuse (youth: OR=3.2, 95%CI:1.5–6.9; adults: OR=1.4, 95%CI:1.1–1.7).
Conclusion: Youth and adults with psychological distress and sleep disturbance are more likely to also report suicidal behaviors. Alcohol and drug use or abuse increase their risk for suicidal behavior compared to those who do not report sleep disturbance. Future work should include examination of causality and of interventions.
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THE RELATIONSHIP BETWEEN PERSONALITY AND SLEEP: SUBJECTIVE COGNITION AS A MEDIATOR

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Introduction: Research has found relationships between sleep quality and personality traits. Poor subjective sleep quality has been observed within individuals scoring high in Neuroticism and low in Conscientiousness. Personality traits have also been associated with cognitive functioning and the link being worse cognition and poor sleep quality is established. However, less is known regarding the role of cognitive functioning in the relationship between personality and sleep quality, particularly in aging populations. This study investigated whether subjective cognition acted as a mediator between individual personality traits and subjective sleep quality in middle-aged and older adults.
Methods: Middle-aged and older adults (N=269; Mage= 64.5, SD=7.8; 123 women/146 men) who were cognitively healthy completed an online survey through Qualtrics measuring demographics, personality (Big Five Inventory-10; BFI-10), self-reported sleep (Pittsburgh Sleep Quality Index; PSQI), and subjective everyday cognition (Cognitive Failures Questionnaire; CFQ). Separate mediation analyses using SPSS PROCESS macro [and testing for indirect effects using 5,000 bootstrapped samples and 95% Confidence Interval (CI) and controlling for conditional associations among all pathways] examined whether subjective everyday cognition (CFQ scores) mediated the relationship between different personality traits (BFI-10 Conscientiousness and Neuroticism scores) and self-reported sleep (PSQI-Total Score), controlling for age and sex.
Results: Neuroticism and PSQI-Total Score was partially mediated by CFQ. There was a significant association between Neuroticism and total PSQI (total effect=0.588, SE=0.110, p<0.001). There were positive associations between Neuroticism and CFQ (a-path effect=2.765, SE=0.383, p<0.001) and CFQ and PSQI (b-path effect=0.068, SE=0.017, p<0.001). The indirect effect was significant (effect=0.187, SE=0.054, 95% CI=0.088 to 0.301). There was no association between Conscientiousness and PSQI-Total Score (total effect=-0.123, SE=0.133, p=0.358), therefore mediation analysis (testing of CFQ as a mediator) was discontinued.
Conclusion: In middle-aged and older adults, subjective everyday cognition mediates the relationship between Neuroticism personality trait and self-reported sleep quality. Individuals scoring higher in Neuroticism report worse subjective sleep quality as their subjective cognitive failures increase. Findings underscore the interacting roles of personality and everyday cognition on perceived sleep. Clinicians should consider individual personality profiles (via personality assessments) and subjective everyday cognitive ratings for a better understanding of the factors impacting middle-aged and older adults' sleep profiles.
Support (if any):

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INSOMNIA PRECEDES SUICIDAL IDEATION IN A NATIONAL LONGITUDINAL STUDY OF SLEEP CONTINUITY (NITES)

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Introduction: Suicide is the 10th leading cause of death among US adults, and disrupted sleep significantly increases suicide risk. It is unclear, however, how quickly changes in sleep can affect suicidal thoughts and behaviors. Therefore, the present study explored whether insomnia, sleep continuity, and nightmares predicted subsequent suicidal thinking.
Methods: Data were drawn from N=1,248 individuals 35 years and older who were part of a 1-year prospective study of the natural history of insomnia. Suicidal ideation was measured biweekly from the Patient Health Questionnaire – 9 and dichotomized (Score = 0, No; Score > 0, Yes). The primary predictors were Insomnia Severity Index (ISI) score and total wake time, total sleep time, difficulty initiating/maintaining sleep, and nightmares (from daily sleep diaries). Predictors were averaged over the previous 2 weeks and measured 2 nights prior to measuring suicidal ideation. Data were modeled using generalized estimating equations to account for within-subject correlations and adjusted for age, sex, and race/ethnicity.
Results: A total of N=124 individuals (65% female) reported suicidal ideation during the study. In unadjusted models, no sleep variable was associated with subsequent suicidal ideation. However, after adjusting for age, sex, and race/ethnicity, insomnia severity was associated with subsequent suicidal ideation when averaged over the preceding 2 weeks (OR 1.09 per point on the ISI, 95% CI [1.03–1.16]) and measured 2 days prior (OR 1.11 per point on the ISI, 95% CI [1.01–1.22]). Stratified analyses showed that this effect was driven by age, with insomnia predicting suicidal ideation in individuals 55–64 and 65 and older.
Conclusion: Insomnia is a significant, proximal risk factor for suicidal ideation, particularly in older adults. Consequently, treatment of insomnia may represent an effective suicide risk reduction strategy.
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THE RELATIONSHIP BETWEEN SLEEP AND SUICIDAL IDEATION IN COLLEGE STUDENTS

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Introduction: Suicide is the second-leading cause of death for young adults and insomnia increases suicide risk. However, the data on disrupted sleep and suicidal ideation in college students is mixed, including whether disrupted sleep fits into the framework of the Interpersonal Theory of Suicide. Therefore, the present study explored how four different sleep variables influenced recent suicidal ideation in a collegiate sample.
Methods: Data from N=506 respondents were collected as part of the Assessing Nocturnal Sleep/Wake Effects on Risk of Suicide (ANSWERS) Survey in college students. The primary outcome, active suicidal ideation in the last 3 months, was assessed using several self-report questions derived from the Columbia Suicide Severity Rating Scale. The predictors were weekday short sleep (≤6h; assessed by retrospective sleep diary), Insomnia Severity Index (ISI) score, Brief Inventory of Sleep Control (BRISC) score, and Disturbing Dreams and Nightmares Severity Index (DDNSI) score. Binomial logistic regression models estimated the associations between suicidal ideation and sleep variables in models that were unadjusted, adjusted for age, sex, race, and ethnicity, and additionally adjusted for thwarted belongingness or perceived burdensomeness (constructs from the Interpersonal Theory of Suicide).
Results: A total of N=121 (23.9%) respondents endorsed suicidal ideation in the last 3 months. Individuals with suicidal ideation were in poorer health (p<0.001) and had more severe depression (p<0.001) and anxiety (p<0.001). In unadjusted models, individuals were more likely to report suicidal ideation if they had short sleep (OR 1.93 [1.23–3.05]), ISI scores of 8 or more (OR 3.01 [1.94–4.74]), and DDNSI scores of 10 or more (OR 2.66 [1.69–4.19]). Higher BRISC scores were associated with lower odds of suicidal ideation (OR 0.53 [0.41–0.68]). Adjusting for age, sex, race, ethnicity, thwarted belongingness, and perceived burdensomeness attenuated but did not eliminate any of these relationships.
Conclusion: Insomnia, short sleep, nightmares, and less perceived sleep control were all associated with recent suicidal ideation in college students. Moreover, these findings were generally independent of the Interpersonal Theory of Suicide. Further research is needed to understand how sleep affects suicide risk in this population, and whether sleep interventions can reduce this risk.
Support (if any):

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PERCEIVED SLEEP CONTROL AND NIGHTMARES DISTINGUISH COLLEGE STUDENTS WITH SUICIDAL IDEATION FROM PAST ATTEMPTERS

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Introduction: Suicidal ideation is common in college-aged students, but this is limited as a risk factor because ideation rarely leads to suicide attempts. Disrupted sleep increases suicide risk, but it is unclear whether this relationship applies equally to both ideators and attempters. Therefore, the present study explored four different sleep variables as discriminators between past suicidal ideation and a past suicide attempt.
Methods: Data from N=506 respondents were collected as part of the Assessing Nocturnal Sleep/Wake Effects on Risk of Suicide (ANSWERS) Survey in college students. The primary outcomes, lifetime history of suicidal ideation or a suicide attempt, were assessed using self-report questions derived from the Columbia Suicide Severity Rating Scale. Predictors were weekday short sleep (≤ 6h; from a retrospective sleep diary), Insomnia Severity Index (ISI) score, Brief Inventory of Sleep Control (BRISC) score, and Disturbing Dreams and Nightmares Severity Index (DDNSI) score. Binomial logistic regression models tested whether these predictors distinguished ideators from attempters. Models were unadjusted, adjusted for age, sex, race, and ethnicity, and additionally adjusted for thwarted belongingness or perceived burdensomeness from the Interpersonal Theory of Suicide.
Results: A total of N=182 (36%) respondents endorsed lifetime suicidal ideation, while N=61 (12%) reported a prior suicide attempt. Attempters tended to be slightly older (p=0.016), in worse health (p<0.001), and have more severe depression (p<0.001) and anxiety (p<0.001) than ideators. In unadjusted models, higher BRISC scores were associated with reduced odds of a suicide attempt (OR: 0.62 [0.42, 0.90]) while DDNSI scores of >=10 were associated with greater odds of a suicide attempt (OR: 4.24 [1.28, 4.24]). Adjusting for age, sex, race, ethnicity, thwarted belongingness, and perceived burdensomeness attenuated but did not eliminate these relationships. Short sleep and ISI scores did not distinguish ideators from attempters.
Conclusion: Perceived sleep control and severity of nightmares, but not insomnia or short sleep, distinguished individuals with a history of suicidal ideation from those with a history of a suicide attempt. However, longitudinal research is needed to determine if poor sleep control or nightmares are proximal predictors of a suicide attempt.
Support (if any):

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SLEEP AND NON-SUICIDAL SELF-INJURY IN COLLEGE STUDENTS

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Introduction: Non-suicidal self-injury (NSSI) can increase suicide risk and is highly prevalent among young adults, including college students. While there is mounting evidence that disrupted sleep increases suicide risk, it is unclear how sleep influences NSSIs. Therefore, the present study explored how sleep variables were associated with NSSIs in a college sample.
Methods: Data from N=506 respondents were collected as part of the Assessing Nocturnal Sleep/Wake Effects on Risk of Suicide (ANSWERS) Survey of college students. The primary outcome, lifetime NSSI, was assessed using a self-report question derived from the Columbia Suicide Severity Rating Scale. The predictors were weekday short sleep (≤ 6h; assessed by retrospective sleep diary), Insomnia Severity Index (ISI) score, Brief Inventory of Sleep Control (BRISC) score, and Disturbing Dreams and Nightmares Severity Index (DDNSI) score. Binomial logistic regression models estimated the associations between NSSI and sleep variables in models that were unadjusted, adjusted for age, sex, race, and ethnicity, and additionally adjusted for thwarted belongingness or perceived burdensomeness from the Interpersonal Theory of Suicide.
Results: A total of N=142 (28.1%) respondents endorsed lifetime non-suicidal self-injury. Individuals with NSSI were more likely to be female (p=0.015), in poorer health (p<0.001), and have more severe depression (p<0.001) and anxiety (p<0.001) than those without NSSI. In unadjusted models, higher BRISC scores were associated with lower odds of NSSI (OR 0.55 [0.43–0.71]), DDNSI scores of >=10 increased the odds of NSSI (OR 2.65 [1.70–4.11], and ISI scores of >=8 increased the odds of NSSI (OR 2.05 [1.38–3.08]), while short sleep was not associated with NSSI. Adjusting for age, sex, race, ethnicity, and thwarted belongingness did not eliminate any of these relationships

but adjusting for perceived burdensomeness rendered the association between insomnia and NSSI non-significant.
Conclusion: Individuals with significant insomnia symptoms or nightmares were more likely to report a history of NSSI, while individuals with greater perceived control of sleep had lower odds of NSSI. These findings were generally independent of the Interpersonal Theory of Suicide. Further research is needed regarding the timing of NSSI (i.e., do they occur more often during nocturnal wakefulness) and whether sleep interventions can reduce the risk of NSSI.
Support (if any):

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POOR SLEEP QUALITY IS ASSOCIATED WITH REDUCED MYELINATION IN PATIENTS WITH PSYCHOTIC DISORDERS

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Introduction: Recent studies show that sleep favors oligodendrocyte proliferation and myelination, and sleep loss is associated with alterations in white matter structure and decreased myelination. Psychotic disorders are characterized by disrupted white matter integrity, and abnormal axon and myelin structure. Despite common sleep disturbances in these disorders, little is known about the relationship between sleep quality and white matter findings. A novel in vivo neuroimaging technique that combines diffusion tensor spectroscopy (DTS) and magnetization transfer ratio (MTR) allows separately examining the axon structure and glial function, and myelin content, respectively. Using this method, we examined the association of sleep quality with white matter biology in a sample of patients with psychotic disorders and matched healthy controls.
Methods: Participants included patients diagnosed with bipolar disorder with psychotic features (euthymic or depressed, n=12) and schizophrenia spectrum disorders (n=9), and age and sex matched healthy controls (n=20). DTS and MTR data was collected from the right prefrontal white matter at 4T. DTS measures included apparent diffusion coefficients of water, NAA, creatine and choline. Sleep quality was measured using Pittsburgh Sleep Quality Index (PSQI).
Results: PSQI total score was significantly higher in patients. and patient sample included a higher percentage of poor sleepers (PSQI total score>5). In patients, total PSQI score and sleep onset latency were significantly and negatively associated with MTR (F=6.9, p=0.02 and F=9.7, p=0.007, respectively). There was no difference in any DTS measures between groups.
Conclusion: Our preliminary results show that poor sleep quality is associated with decreased myelin content in the frontal lobe, in patients with psychotic disorders. This finding suggests that sleep loss may be a mediator of white matter alterations in psychosis.
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EFFECTS OF LIFETIME TRAUMA EXPOSURE ON THE ASSOCIATION BETWEEN NEIGHBORHOOD SAFETY AND SLEEP

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Introduction: Greater perceived neighborhood safety (PNS) has been linked to better sleep quality and longer sleep duration. There is also evidence that past exposure to traumatic events may be associated with lower perceived personal safety and poor mental health. Yet, the moderating effects of lifetime trauma exposure on the association between PNS and sleep (duration & latency), has not been assessed.
Methods: We used cross-sectional data from 190 healthy NYC Latino adults. Lifetime trauma exposure was measured using the Life Events Checklist [LEC] (a count of traumatic events that happened to or were witnessed). In the first set of models, we regressed self-reported sleep duration in minutes (continuous), on PNS (safe vs. not safe), a single item scale, with three covariates (i.e. age, gender, education). In the second set, self-reported sleep latency in minutes, replaced sleep duration. To test for moderation, interaction terms—LEC x PNS—were added to covariate-adjusted models. In sensitivity analyses, regression models were re-run with adjustment for PTSD symptoms, and with short sleep duration (<7hours) as the outcome.
Results: On average, participants were 37.9 years old (SE= 1.02), 65.8% female, 59.5% foreign-born, and 33.2% completed < Bachelor's degree. Overall, 43.68% slept <7 hours and 83.68% were exposed to >1 traumatic event in their lifetime. In adjusted models, each traumatic event (b= -2.95, SE = 1.34, p=0.03) was negatively associated with sleep duration. When PTSD symptoms was added, trauma was no longer statistically significant (b=-1.08, SE=1.02, p=0.18). However, each traumatic event exposure was associated with a 10% higher odds of short sleep duration (OR= 1.10, CI=1.02, 1.15), and this association remained significant with adjustment for PTSD symptoms. No interaction terms were significant. In models for sleep latency, there were no statistically significant main effects for LEC or interaction terms.
Conclusion: We found a dose response in the negative association between lifetime exposure to trauma and sleep duration, but not sleep latency. Trauma history did not moderate the association between PNS and sleep. These results suggest that short sleep duration may be particularly sensitive to lifetime exposure to trauma independent of neighborhood safety. Future studies should replicate these results in population-based samples.
Support (if any):

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PERCEIVED DEPRIVATION OF SOCIAL TOUCH AND SLEEP SYMPTOMS: RESULTS FROM A PRE-COVID19 COMMUNITY STUDY

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Introduction: The impact of social isolation and touch deprivation on sleep symptoms (insomnia, nightmares) during the SARS-CoV-2 (COVID19) pandemic has been recognized. These results however may have been confounded by various other disease-related factors that can directly impact sleep eg., medical complications associated with COVID19; trauma response and the economic impact of the pandemic. We examined previously unpublished data, from an earlier Canadian community-based survey (1997–1998) of psychosomatic factors (including sleep symptoms), associated with perceived touch deprivation (PTD).
Methods: 360 consecutive consenting participants (316 community volunteers,44 psychiatric outpatients; 270 women; 94% white; mean±SD age: 38.3±14.5 years) completed a large battery of questions related to psychosomatic factors and the skin. The methods are described in previous publications [Gupta MA 2004; Gupta MA 2006] from this study. PTD was measured with the following item (rated on a 10-point Likert-type scale where "0" denoted "not at all" and rating of "9" denoted "very markedly"): "At the present time I wish I could get more hugs from others'". Some of the sleep ratings in the survey read as follows: Insomnia1: "How long do you generally take to fall asleep at night?"(rating of "1" denoted "immediately", "2" denoted

"1hour"). Secondly, participants rated how frequently they experienced the following sleep symptoms using a 4-point scale: "Awakenings from sleep"(Insomnia 2); "Dreams"; "Nightmares: "Snoring"; and "Jerking of arms or legs" (rating of "1" denoted "Never", "2" denoted "Sometimes", "3" denoted "Often", 4 denoted "Always").
Results: PTD scale scores (mean±SD: 3.81±2.85; range 0–9) correlated significantly with the following: Insomnia1 ($r=0.219$, $p<0.001$); Insomnia2 ($r=0.130$, $p=0.014$); Nightmares ($r=0.118$, $p=0.018$); Limb jerking ($r=0.209$, $p<0.001$), and age ($r=-0.208$, $p<0.001$). Stepwise multiple regression analysis using PTD as dependent variable and all sleep ratings, age and sex as independent variables revealed the following predictors for PTD: Insomnia1($\beta=0.171$,$t=3.3267$, $p=0.001$), Limb jerking ($\beta=0.151$,$t=2.876$, $p=0.004$), age ($\beta= -0.179$, $t= -3.456$, $p=0.001$).
Conclusion: In a pre-COVID19 community study, PTD was more problematic among the younger age group, and correlated with sleep onset and maintenance difficulties, nightmares and limb jerking, highlighting the importance of social touch in sleep.
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INSOMNIA IS ASSOCIATED WITH ANGER EXPRESSION IN AN ARMY POPULATION

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Introduction: Emotion-regulation and sleep-related difficulties are intertwined. Most research has focused on the impact of poor sleep on internalizing symptoms (e.g. depression, anxiety) but a few studies have found a that increased insomnia is associated with more externalizing symptoms (e.g. anger). This relationship may be particularly salient for military personnel, for whom poor sleep is endemic. It is important that this relationship be further investigated in order to understand the issues that Army servicemembers face.
Methods: Data were acquired from the All Army Study of the Army Study to Assess Risk and Resilience in Servicemembers (STARRS; N=21,449; 18–61 years old; 86.5% male). Participants completed the Brief Insomnia Questionnaire, an 11-item irritability and anger-related questionnaire and a 10-item questionnaire on anger attacks. Pearson correlations were used to examine the relationship between insomnia symptoms and emotional and behavioral components of anger, while controlling for depressive symptom severity.
Results: Insomnia severity in the past 30 days was significantly correlated with both emotional and behavioral expressions of anger (all $p<0.001$, $r = .2$ to $.4$). Overall insomnia severity and early morning awakenings (EMA) had the strongest relationships. These relationships were still significant after controlling for depression severity.
Conclusion: In a nationally-representative sample of Army servicemembers, insomnia severity, particularly EMA, was associated with higher levels of irritability and anger (outbursts and anger attacks) over and above the effects of depression. These findings highlight the importance of treating insomnia in order to regulate anger expression within a military population.
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SLEEP RESTRICTION REDUCES FEELINGS OF INTERPERSONAL CONNECTEDNESS AND SOCIAL MOTIVATION

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Introduction: Feeling socially connected with others is essential for promoting and maintaining psychological health. Emerging research suggests that insufficient sleep may result in deleterious social outcomes such as greater reactivity to stressful social situations. However, little is known regarding how sleep may impact motivation to feel connected with others, and experiences of connectedness after positive social interactions.
Methods: Healthy participants (N = 56; 83.9% female, ages 18–30) were randomly assigned to one night of sleep restriction (SR, 4 h) or a night of typical sleep (TS, 8 h) in a controlled laboratory setting and verified with actigraphy. All participants did not have any known or suspected sleep or psychiatric disorders, were free of medical conditions and current medication use known to impact sleep and/or psychological functioning, and wore an actigraph for one week prior to the experimental night to ensure adequate sleep duration. Following the experimental night, participants reported on their motivation for social connectedness (e.g., "Right now, I would like to be close with friends, family, and significant others."), and completed a task where they spent 5 minutes writing about a positive interpersonal event. After the task, participants reported on their feelings of interpersonal connectedness. Qualitative text analysis was conducted to extract emotional tone and number of social words used during the task.
Results: Compared to TS, participants undergoing SR were less motivated to feel connected with others [$t(54) = -2.62$, $p = .01$], and reported feeling less social connectedness after the task [$t(53) = -2.06$, $p = .04$]. Text analysis revealed no differences in positive or negative emotional tone, but participants in the SR group used less social words when describing their positive interpersonal event [$F(1, 53) = 6.65$, $p = .01$], even after adjusting for differences in total number of words used.
Conclusion: One night of sleep restriction reduces motivation to engage in social interactions, and also results in feeling less connected with others after reflecting on a positive social event. These findings add to a limited body of research on sleep and social experiences and provide further support for the negative psychological effects of sleep loss.
Support (if any):

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EARLY LIFE ADVERSITY AND CENTRAL SYMPTOMS OF SLEEP DISTURBANCE: A NETWORK ANALYSIS

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Introduction: Individuals with early life adversity (ELA) experience a greater likelihood of sleep disturbance. Sleep disturbance is a hypothesized mechanism underlying the association between ELA and adverse health outcomes. However, it is unclear whether sleep disturbance presents differently in individuals with ELA when compared to individuals without ELA. Network analysis provides an analytic framework to examine the relationships and magnitudes of association between symptoms of sleep disturbance. Using a network framework,

we investigated the differences in sleep disturbance symptoms between individuals with ELA and individuals without ELA.
Methods: College students (N=507; age=18±1, Female=72%) completed demographic measures, the Childhood Trauma Questionnaire (CTQ), and the Pittsburgh Sleep Quality Index using an online data collection platform from March-December 2020. Using clinical cutoffs, individuals with ELA were separated from individuals without ELA. Using the Pittsburgh Sleep Quality Index (PSQI; alpha=0.79), sleep disturbance was assessed. Two 7-node ELA-specific networks were generated using raw values for the 7 components of the PSQI. To assess network accuracy, stability coefficients were estimated using the 'bootnet' and 'qgraph' packages in R. The strength of association between each component and all other components of sleep disturbance were estimated using expected influence (EI). Network structures and measures of EI were examined for differences between exposure groups.
Results: Overall, the average global PSQI score was 7.50±3.37. Individuals with ELA had larger global PSQI scores when compared to individuals without ELA (8.18 versus 6.97, t=3.8, p<0.001, d=0.37). For individuals with ELA, sleep quality, duration, and efficiency were most associated with other symptoms of sleep disturbance. For individuals without ELA, subjective sleep quality, sleep latency, and daytime dysfunction were most related to other symptoms of sleep disturbance. Individuals with ELA demonstrated a more interrelated network structure, with greater raw measures of EI in most components of the PSQI.
Conclusion: For individuals with ELA, duration and efficiency strongly underly sleep disturbance. Moreover, most symptoms had greater measures of EI in individuals with ELA when compared to individuals without ELA, suggesting that symptoms of sleep disturbance may be more likely to co-occur in individuals with ELA. Future research may explore the utility of these symptoms in predicting adverse health outcomes.
Support (if any):

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NATURALISTIC MEASUREMENT OF SLEEP/WAKE DISTURBANCE IN ADULTS RECEIVING METHADONE TREATMENT FOR OPIOID USE DISORDER

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Introduction: Individuals with opioid use disorder (OUD) report significant sleep/wake disturbance, which continues even after stabilization on medication-assisted treatment (MAT). However, the nature of sleep/wake disturbance in this population has not been well documented objectively. Here we analyze naturalistic wrist actigraphy recordings in individuals with OUD receiving methadone-based MAT.
Methods: Seven adults undergoing methadone treatment for OUD (ages 26–50; 4 women) wore a wrist actigraph (Actiwatch-2, Philips Respironics) continuously for 7 days. They were asked to adhere to their normal sleep schedule in order to obtain naturalistic observations. Reference data were collected in a separate study of healthy controls, in which 14 hospital nurses (ages 20–60; 13 women) wore a wrist actigraph continuously for 7 days. In this reference group, 7 participants had a day shift schedule (07:00–19:00) and 7 had a night shift schedule (19:00–07:00), with six 12h shifts in a 2-week period. Actigraphic data were collected in 1min epochs, and the sleep/wake status for each epoch was estimated using Actiware 6.0.9 (Philips Respironics). The estimated sleep/wake patterns were subjected to cosinor analysis to assess 24h rhythmicity and analysis of the distribution of inactive periods to assess sleep continuity.
Results: For the reference group, nurses working day shifts displayed strong 24h rhythmicity, whereas nurses working night shifts showed blunted 24h rhythmicity ($F[1,12]=66.11$, $p<0.001$). However, both day and night nurses exhibited high sleep continuity (KS test, $p=0.82$). By contrast, for the group with OUD receiving methadone, the strength of 24h rhythmicity was reduced to between that of the day and night shift nurses in the reference group, indicating weak regularity of sleep/wake patterns ($F[2,18]=33.79$, $p<0.001$). Furthermore, individuals with OUD receiving methadone experienced low sleep continuity compared to the reference group (KS test, $p=0.030$).
Conclusion: These naturalistic observations confirm the presence of sleep/wake disturbance, resulting from both irregular sleep/wake patterns and low sleep continuity, in individuals receiving methadone-based MAT for OUD. Sleep/wake disturbance may interfere with the ability to achieve OUD recovery goals, and comparing sleep disturbance in MAT populations to reference data highlights the need to consider sleep in these populations as a clinical priority.
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REPORTED RESTFUL SLEEP PREDICTING EMOTIONAL DISTRESS: DOES EXERCISE (AND ITS MODALITIES) MODERATE?

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Introduction: Literature shows that exercise moderates the relationship between sleep and emotional distress (ED.) However, it is unclear whether different types of exercise, such as aerobic and strengthening, affect this relationship differently. We investigated the moderating role of two types of exercise (aerobic and strengthening) regarding the relationship between ED and sleep.
Methods: Our analysis was based on data from 2018 National Health Interview Survey (NHIS), a nationally representative study in which 2,814 participants provided all data. Participants were asked 1) "how many days they woke up feeling rested over the past week", 2) the Kessler 6 scale to determine ED (a score >13 indicates ED), and 3) the average frequency of strengthening or aerobic exercise per week. Logistic regression analyses were performed to determine if the reported days of waking up rested predicted level of ED. We then investigated whether strengthening or aerobic exercise differentially moderated this relationship. Covariates such as age and sex were adjusted in the logistic regression models. Logistic regression analyses were performed to determine if subjective reporting of restful sleep predicted level of ED. We investigated whether strengthening exercise or aerobic exercise differentially moderated this relationship. Covariates such as age and sex were adjusted in the logistic regression models.
Results: On average, participants reported 4.41 restful nights of sleep (SD =2.41), 3.43 strengthening activities (SD = 3.19,) and 8.47 aerobic activities a week (SD=5.91.) We found a significant association between days over the past week reporting waking up feeling rested and ED outcome according to K6, $X2(1) = -741$, $p = <.001$. The odds ratio signified a decrease of 52% in ED scores for each unit of restful sleep (OR = .48, (95% CI = .33, .65) $p=<.001$.) In the logistic regression model with moderation, aerobic exercise had a significant moderation effect, $X2(1) = .03$, $p=.04$, but strengthening exercise did not.
Conclusion: We found that restful sleep predicted reduction in ED scores. Aerobic exercise moderated this relationship, while

strengthening exercise did not. Further research should investigate the longitudinal effects of exercise type on the relationship between restful sleep and ED.

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TRAIT EXTRAVERSION IS ASSOCIATED WITH INCREASED SUICIDAL IDEATION DURING TOTAL SLEEP DEPRIVATION AND INSOMNIA

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Introduction: It is known that sleep disturbance is associated with increased suicidal thinking, and completed suicides are most common during the late night/early morning hours, but no studies have examined the role of trait-like individual differences in vulnerability to suicidal ideation during sleep deprivation or insomnia. In two separate studies, we examined whether the trait of extraversion is predictive of changes in suicidal thinking following two nights of sleep deprivation and among individuals meeting criteria for insomnia.

Methods: Study 1: Twenty-five healthy military personnel (20 males), ages 20–35 completed the NEO-PI-R Extraversion scale and the Suicidal Ideation (SUI) scale of the Personality Assessment Inventory (PAI). Participants completed 77 hours of continuous sleep deprivation. After 56 hours of sleep deprivation, participants completed the SUI scale a second time. Study 2: 1,011 adults aged 18–79 (470 males) were divided into two groups based on the clinical threshold (≥15) on the Insomnia Severity Index (ISI) and completed measures of extraversion and depression, including the suicide item of the Patient Health Questionnaire-9 (PHQ9).

Results: Study 1: After controlling for caffeine group and changes in PAI Depression, Extraversion scores were used to predict changes in SUI scores using stepwise multiple linear regression. Higher Extraversion was significantly associated with increased non-clinical suicidal ideation following sleep loss, β=.463, partial r=.512, p=.013. Study 2: After controlling for depression, extraversion was more strongly correlated with greater suicidal ideation, particularly for those meeting criteria for insomnia, β=.340, partial r=.387, p<.0000001, compared to those below the threshold, β=.185, partial r=.218, p<.0000001.

Conclusion: Higher trait extraversion was associated with increased vulnerability to suicidal ideation between rested baseline and total sleep deprivation, and was associated with greater suicidal ideation among those meeting criteria for clinically severe insomnia. These findings point to a potential trait-like vulnerability factor that may further our understanding of sleep disruption in the phenomenology of suicide.

Support (if any):

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OSA RISK IS ASSOCIATED WITH NUMBER OF WHITE MATTER HYPERINTENSITIES, BUT HISTORY OF MILD TBI IS NOT: A LIMBIC-CENC STUDY

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Introduction: Individuals with a history of mild traumatic brain injury (mTBI) have higher risk levels for obstructive sleep apnea (OSA). However, no studies have examined the association between OSA and white matter hyperintensities (WMHs) in this group. The purpose of this study is to explore the relationship between OSA risk, mTBI, and WMHs in a military cohort with a history of combat deployment.
Methods: Secondary analyses were conducted from a large clinical database of a multi-center, longitudinal study of current and former military personnel. Participants were included who had complete STOPBANG (sleep apnea risk) data and MRI. Univariable and multivariable regressions were conducted, including age, race, gender, education, hypertension, diabetes, history of mTBI, and STOPBANG score in the models.
Results: The final sample (N=1017) included participants with (n=823) and without (n=194) a history of mTBI. The sample was predominantly male (87%) with a median age of 38 (IQR; 32–48). WMHs were reported in 37% of the sample. Univariate analyses revealed that increasing age, female sex, hypertension, diabetes, and higher sleep apnea risk score were each positively associated with higher number of WMHs, while a history of lifetime mTBI exposure was not associated. Multivariable analyses revealed that of these factors, only age remained associated with WMH presence. When restricting the sample to the 37% with WMHs, OSA risk and female sex were each associated with higher number of WMHs ($p<.05$), but history of mTBI was not.
Conclusion: Consistent with the literature in non-brain injured populations, age was the strongest predictor of WMH presence and number. In those with identified WMHs, OSA risk was a significant predictor of WMH number, while history of mTBI was not. Thus, in persons with mTBI, presence of WMHs may be linked to sleep comorbidities, providing potential treatment targets. Limitations include assessment of OSA rather than established diagnosis.
Support (if any): Defense and Veterans Brain Injury Center (HT0014-19-C-004), DOD(W81XWH-13-2-0095), VA(I01 CX001135). The views expressed in this abstract are those of the authors and do not necessarily represent the official policy or position of the Defense Health Agency, Department of Defense, or any other U.S. government agency. For more information, please contact dha.TBICoEinfo@mail.mil. UNCLASSIFIED

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IS DYSPHAGIA A MARKER FOR OBSTRUCTIVE SLEEP APNEA (OSA) IN TRAUMATIC BRAIN INJURY (TBI) PATIENTS: A VA TBI MODEL SYSTEM STUDY

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Introduction: Recent work has highlighted prevalent obstructive not central sleep apnea following traumatic brain injury (TBI). Treatment of comorbid OSA may facilitate neurologic recovery but widespread screening is limited. Mixed support exists for the presence of dysphagia as a biomarker of OSA in the general population and stroke patients. Dysphagia is common following TBI; however, no study has examined the relation between OSA and dysphagia in this cohort. Leveraging data from a recent six-center clinical trial of OSA and TBI during inpatient rehabilitation, this secondary analysis examined the association between OSA severity indices and proxy measures of dysphagia.
Methods: Level 1 polysomnography (PSG) was used to assess OSA (AHI ≥ 5 and ≥ 15) during inpatient rehabilitation for the overall sample (N=248; 203 male; 60.6% severe injury) evaluated at a median of 120.6 days post-TBI and subset ≤ 60 days post-injury. Dysphagia was approximated as the presence of a PEG tube and/or a modified texture diet (MTD) on the day of PSG. Chi square and Fisher's Exact tests were utilized for group comparisons.
Results: As previously reported, OSA in this cohort was prevalent (68.2% (n=169) at AHI ≥ 5 and 33.5% (n=83) AHI ≥ 15) with predominantly obstructive events. 27.4% (n=68) met criteria for dysphagia combining proxy measures (34 peg; 49 MTD). No significant difference was found for presence of dysphagia across OSA severity cutoffs (AHI ≥ 5 & 15; p=0.1029 & 0.5959). When examining OSA across the individual proxy measures, persons without a peg tube were significantly more likely to have OSA at AHI ≥ 5 (62.5% vs 5.65%; p=0.0003) and AHI ≥ 15 (31.05% vs 2.42%; p=0.0353). When examining participants less than 60 days post-TBI, the group differences remained.
Conclusion: The incidence of dysphagia in TBI patients, as indexed by a modified diet or presence of a feeding tube, was not elevated in those with OSA. Sample bias (for undergoing Level 1 PSG and improvement facilitating inpatient rehabilitation admission) may have contributed to findings. Finally, future work with more sensitive indices of dysphagia is needed to accurately evaluate this association.
Support (if any): PCORI (CER-1511–33005), NIIDLRR (90DPTB0004)

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OBSTRUCTIVE SLEEP APNEA (OSA) AND VESTIBULAR DYSFUNCTION IN PATIENTS WITH TRAUMATIC BRAIN INJURY (TBI)

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Introduction: Recent work has highlighted prevalent OSA after TBI. Vestibular dysfunction is also common and associated with adverse outcomes particularly in military personnel. Vestibular dysfunction has been identified in patients with moderate to severe OSA, yet the relationship remains unexplored in those with TBI. This study examined the relationship of vestibular dysfunction with OSA in a large cohort of Veterans and Military Service Members (V/SM) with documented TBI.
Methods: Data are secondary analyses from a five-center prospective observational cohort study of V/SM admitted for inpatient rehabilitation for TBI and enrolled in the VA TBI Model Systems. Participants completing study measures from 2015 to March of 2020 were included in analyses. Study measures includes the Centers for Disease and Control's National Health and Nutrition Education Survey (NHANES, OSA

item embedded) epidemiologic survey and Neurobehavioral Symptom Inventory (NSI). T-tests and chi-square tests compared patients with OSA to those without OSA on the vestibular subscale on the NSI.
Results: The sample was mostly male (93%), a mean of 38 years of age, and predominantly with mild (52%) or severe (41%) TBI. OSA was reported in 30.6% on the NHANES. Vestibular symptoms were more common among those with OSA (24%) compared to those without (12%) with a significant difference on the NSI Vestibular Total Score (3.84 vs 2.88 respectively; $p<0.001$). Similar results were seen across all three NSI vestibular items (dizziness, balance difficulties, poor coordination).
Conclusion: Participants with TBI and comorbid OSA are more likely to endorse the presence and greater severity of vestibular symptoms compared to those without OSA. Future research is needed to improve understanding of the inter-relationship of OSA and vestibular dysfunction to inform clinical management.
Support (if any): VA TBIMS & TBICoE (HT0014-19-C-0004), NIDILRR, North Texas TBI Model System (Grant #90DPTB0013), TIRR TBIMS (Grant #90DPTB0016)

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ADAPTIVE BODY AWARENESS MEDIATES THE RELATIONSHIP BETWEEN QUALITY OF SLEEP AND SYMPTOMS OF CENTRAL SENSITIZATION

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Introduction: Sleep disturbance is associated with chronic pain. Central sensitization (CS), defined as the amplification of neural signaling within the central nervous system that results in pain hypersensitivity, may be one pathway through which sleep disturbance contributes to chronic pain. Sleep disturbance and CS are both associated with maladaptive body awareness, characterized by increased hypervigilance and catastrophizing in response to body sensations. Impaired sleep, increases maladaptive body awareness, which then contributes to CS. Less is known about the relationship between quality sleep, adaptive body awareness (i.e., increased attention to and awareness of body sensations, devoid of negative evaluations of sensations), and CS. Primary aims were to evaluate mediational pathways through which (1) sleep disturbance might be related to increased pain intensity via CS-related symptoms and (2) quality sleep might be related to lower CS-related symptoms via adaptive body awareness.
Methods: In a cross-sectional study, online surveys were administrated to 301 individuals with chronic pain. Pearson's correlations characterized overall relationship between self-reported sleep quality (PROMIS-Sleep), adaptive body awareness (Multidimensional Assessment of Interoceptive Awareness; MAIA-2), and CS-related symptoms (Central Sensitization Inventory; CSI). Two path analyses using PROCESS were conducted.
Results: Results revealed that a one-unit increase in sleep disturbance was associated with a 1.7 unit increase in pain intensity, which was partially explained by CS-related symptoms [point estimate=.16; 95% bootstrap confident intervals (CI)=0.10 to 0.22]. In a separate path analysis, a one-unit decrease in sleep disturbance was associated with a 3.5 unit decrease in CS-related symptoms, which was partially explained via adaptive body awareness [point estimate=.25; 95% CI=0.03 to 0.52].
Conclusion: Novel findings provide greater understanding into pathways through which sleep might contribute to chronic pain. Results support longitudinal studies to explore effects of sleep and adaptive body awareness on self-reported symptoms and biological markers of CS within chronic pain populations.
Support (if any):

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ASSOCIATION OF OBSTRUCTIVE SLEEP APNEA SEVERITY AND NOVEL PLASMA BIOMARKERS OF ALZHEIMER'S DISEASE PATHOLOGY

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Introduction: Recent evidence suggests novel plasma Alzheimer's Disease (AD) pathology biomarkers have high potential for AD risk prediction. We determined whether obstructive sleep apnea (OSA) severity is associated with plasma levels of Aβ40, Aβ42, Aβ42/Aβ40, Tau, tau/Aβ42 and NfL and whether this relationship is dependent of amyloid burden.
Methods: Cross-sectional analysis of baseline data from 120 community-dwelling, cognitively normal older-adults, selected from ongoing NYU prospective longitudinal studies on memory, sleep and aging. Of the 120 participants, 70 had baseline CSF-Aβ42 (measured using ELISA). OSA-severity was defined using AHI4% criteria. Levels of plasma Aβ40, Aβ42, Tau and NfL were determined using single molecule array technology ultra-sensitive assays. Associations of OSA-severity and plasma AD-biomarker levels (n=120) were assessed using Pearson correlation analysis. The association of OSA-severity and AD plasma biomarkers dependent on CSF-Aβ42 levels (n=70) was assessed using generalized linear models. Analyses were adjusted for age, sex, BMI, race, education and APOE4.
Results: Of the 120 participants, 80 (67%) were women. Mean (SD) age was 69.1 (7.2) years. Mean (SD) AHI was 14.3/hr. (16.3) {48 (40%) had AHI <5, 30 (25%) had AHI: 5 to ≤ 15, 18 (15%) had AHI: 15 to ≤30, and 22 (18%) had AHI >30}. Independent of amyloid-burden, OSA-severity was associated with higher levels of plasma Aβ40 (r=.21, p-value=.02), plasma Aβ42 (r=.26, p-value=.01), plasma Aβ42/Aβ40 (r=.20, p-value=.05), but not plasma Tau, plasma tau/Aβ42 or plasma NfL. The association of OSA-severity and plasma levels of Tau, Tau/Aβ42 or NfL dependent on CSF-Aβ42 levels revealed significant interactions between CSF-Aβ42 levels and AHI (p-value <.05 for all), with β-estimates suggesting that with combined increases in AHI and decreases in CSF-Aβ42 levels, there were corresponding increases in plasma levels of Tau, plasma Tau/Aβ42 or plasma NfL. The analysis was not powered for generating dichotomized strata specific (i.e. OSA+/Aβ+, OSA+/Aβ-, OSA-/Aβ+ and OSA-/Aβ-) estimates.
Conclusion: In this sample of cognitively-normal older- adults, OSA-severity was associated with levels of plasma Aβ40, Aβ42, Aβ42/Aβ40 and showed a synergistic effect with CSF Aβ42 on plasma levels of tau and NfL. Larger cohorts are necessary to delineate mechanisms and examine for OSA/Aβ strata-specific estimates.
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SLEEP AND DAYTIME FUNCTION IN PATIENTS WITH MULTIPLE SCLEROSIS

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Introduction: Fatigue is a core symptom of Multiple Sclerosis (MS) and impairs function and quality of life. Studies show that sleep-disordered breathing (SDB) is also common in persons with MS and may exacerbate fatigue. Within a larger study of patients with spinal cord injuries and disorders, we evaluated the relationships among sleep-disordered breathing severity, sleep quality, and functional outcomes in patients with MS. Our objective was to examine the impact of SDB severity and sleep quality on the severity of fatigue and functional impairment in this population.
Methods: Twenty-five subjects (average age=57(11), min=35, max=79; 80% male; average AHI=27(20) min=3, max=70; and 67% with AHI > 15) 24 completed in-laboratory polysomnography (PSG) to measure apnea-hypopnea index (AHI) and sleep efficiency (SE) and questionnaires about sleep and function: Insomnia Severity Index (ISI), Pittsburg Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Flinders Fatigue Scale (FFS), PHQ-9 depression scale (excluding sleep item), Brief Pain Inventory (BPI) and World Health Organization Quality of Life (WHOQOL). Relationships between sleep measures (AHI and SE from PSG, ISI and PSQI) and daytime function (ESS, FFS, PHQ-9, BPI and WHOQOL) were assessed by bivariate correlation.
Results: At the baseline visit, we assessed participant's daytime sleepiness, fatigue, sleep quality, and depression. The mean scores on questionnaires: ESS was 8.0(5.6), ISI was 11.5(6.7), PSQI was 9.3(4.4), FFS was 17.3(8.7), BPI severity was 3.4 (3.13), BPI interference was 3.5 (3.5), PHQ-9 was 7.3(5.8). There were significant relationships between ISI and FFS (r=0.78, p<0.001), PSQI and FFS (r=0.68, p=0.001), ISI and WHOQOL Physical Domain (r=-0.64 p=0.001), as well as SE and FFS (r=-0.45, p=0.041). There was no significant correlation between AHI and FFS (p=0.395).
Conclusion: In veterans with MS, insomnia symptom severity was associated with daytime fatigue and decreased quality of life (QOL). Insomnia may represent a modifiable cause of daytime fatigue in patients with MS. Recognition and management of insomnia may improve outcomes in this population. Further research should evaluate whether insomnia interventions may benefit daytime fatigue and improve QOL.
Support (if any): VA Rehabilitation Research and Development Service, (RX002116; PI Badr); VA HSR&D RCS20-191 and NIH/NHLBI K24 HL143055 (PI Martin).

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OBSTRUCTIVE SLEEP APNEA AND HYPOVENTILATION IN PATIENTS WITH MUSCULAR DYSTROPHIES: ANALYSIS OF 42 POLYSOMNOGRAM STUDIES

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Introduction: Patients with muscular dystrophies (dystrophinopathy, congenital muscular dystrophy and limb-girdle muscular dystrophy) are at greater risk of obstructive sleep apnea (OSA). However, few studies have examined if they are also at risk for hypoventilation and its relationship with OSA. We hypothesize that these two conditions occur independently of each other as an impaired ventilator drive and diaphragm weakness.
Methods: Retrospective review of diagnostic polysomnograms (PSG) in a tertiary care facility over 15 years was conducted. The polysomnography included either end tidal CO2 or transcutaneous CO2 measurements. Descriptive data analysis was performed on results described. We computed Pearson correlation coefficients to examine the relationships between PSG indices and other parameters. Pearson's Chi-squared test with Yates' continuity correction is used to test if hypoventilation is independent from OSA.
Results: 42 PSG studies in patients with muscular dystrophies were included after excluding 2 studies due to insufficient sleep duration. The average age at the time of study was 14.2 yrs with 41 being male and average BMI of 24.1. 64% of the group met the definition for OSA with average AHI 8.0. 36% of the group met the criteria for hypoventilation, and 33% patients with hypoventilation did not have OSA. Chi squared analysis (p=1.0) shows that hypoventilation is independent of OSA.
Conclusion: Sleep disordered breathing is common in patients with muscular dystrophy. This study supports that OSA and CO2 retention may be independent processes.
Support (if any):

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CONTRIBUTION OF SLEEP DISORDERS TO DEMENTIA INCIDENCE FOLLOWING TRAUMATIC BRAIN INJURY: A DECADE-LONG RETROSPECTIVE COHORT STUDY.

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Introduction: We aimed to examine the association between sleep disorders and dementia risk in a population-based cohort of adult male and female patients with traumatic brain injury (TBI).
Methods: We studied a province-wide retrospective cohort of all adult patients (≥ 18 years) free of dementia at the admission to the emergency department or acute care hospital with diagnoses of TBI between May 2003 and April 2013. All patients were followed through until May 2016. The primary exposure was a sleep disorder, and the primary outcome was dementia, both defined by the International Classification of Diseases, tenth revision diagnosis. Associations of sleep disorders with dementia were analyzed in multivariate Cox Proportional Hazard modeling.
Results: In total, 712,708 patients with TBI of all severities were included in this study. Their median age was 44 years, 59% were males. Over a median follow-up of 52 months (interquartile range, 19–86 months), 32,834 (4.6%) developed dementia. Controlling for age, sex, income level, injury severity, and known comorbidity risks, diagnosed sleep disorder was a significant predictor of incident dementia: hazard ratio (HR), 1.250 [95% CI, 1.146–1.363]. When results were stratified by sex, the association of sleep disorder with dementia remained significant in male: HR 1.255 [95% CI, 1.112–1.415] and in female patients: HR 1.234 [95% CI, 1.088–1.400]. Sensitivity analyses on Alzheimer's disease case definition and using Fine and Gray competing risk models confirmed the association between sleep disorder and dementia in both sexes.
Conclusion: In both sexes, sleep disorders were independently associated with dementia onset (adjusted HRs>1.2). Thus, screening for sleep disorders should be part of regular care for TBI patients, as with the steady increase of TBI survivorship and life expectancy, undiagnosed sleep disorders can initiate a new cascade of cognitive deficits independent from TBI.
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REAL WORLD CHALLENGES AND BARRIERS FOR POSITIVE AIRWAY PRESSURE THERAPY USE IN ACUTE ISCHEMIC STROKE PATIENTS

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Introduction: Untreated obstructive sleep apnea (OSA) in patients with acute ischemic stroke (AIS) increases morbidity and mortality post-stroke. However, diagnosing and treating OSA in AIS is challenging. As such, we aimed to determine the feasibility of portable monitoring (PM) for diagnosis and positive airway pressure (PAP) therapy for treatment of OSA in an inpatient stroke population.
Methods: We recruited inpatients with AIS from the Cleveland Clinic. Those who consented underwent PM; participants with a respiratory event (REI) ≥10 were offered auto-titrating positive airway pressure therapy (APAP). Ease-of-use questionnaires were completed. We summarized categorical variables using n(%) and continuous variables using mean±SD or median [IQR].
Results: 27 participants (age 59.8±11.8, 51.9% female, 51.9% African American, BMI 33.3±11.4) enrolled. The study ended early due to Medicare contracting that forced most patients to complete stroke rehabilitation outside the Cleveland Clinic health system. 69.6% had large vessel occlusions and 52% had moderate/severity disability (Modified Rankin score ≥2). PM was attempted in 23 participants and successful in 19. Nursing and patients rated the PM device as highly easy to use. 11 of 14 patients who had an REI ≥10 consented to APAP titration, but only 5 continued APAP after discharge. Four patients who initially said APAP was easy to use noted that their stroke interfered with their APAP use at home.
Conclusion: This study demonstrates the challenges in the assessment and treatment of OSA in an acute ischemic stroke population, highlighting the necessity for further research into timely and feasible screening and treatment.
Support (if any): ResMed

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QUANTITATIVE EEG ANALYSIS IN ANGELMAN SYNDROME

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Introduction: Angelman syndrome (AS) is a neurodevelopmental disorder resulting from decreased expression of the maternal copy of the imprinted UBE3A gene on chromosome 15. This disorder is characterized by intellectual disability, impaired speech and motor skills, and sleep abnormalities but currently lacks any treatment. However, mouse models have shown that un-silencing the dormant paternal copy of UBE3A has been an effective mechanism to restore the functionality of the UBE3A protein, thus clinical trials using this approach are on the near horizon. Developing biomarkers is essential for assessing responses to treatment when clinical trials begin, and quantitative EEG analysis has shown great promise as a biomarker for AS.
Methods: Here, we sought to define EEG biomarkers directly linked to sleep impairments seen in up to 90% of individuals with AS (Trickett). We analyzed nine overnight sleep studies from patients with AS with age and sex matched Down syndrome and neurotypical controls. We specifically examined low-frequency delta rhythms and sleep spindles during NREM sleep.
Results: We confirmed that low- delta rhythms are increased during overnight sleep in AS, and that this biomarker appears more reliable than possible changes in sleep spindles.
Conclusion: Our results suggest that quantitative measurement of delta rhythms during sleep can be used as a potential biomarker for treatments in Angelman syndrome clinical trials.
Support (if any):

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OBSTRUCTIVE SLEEP APNEA IS A RISK FACTOR FOR SUDDEN UNEXPLAINED DEATH IN EPILEPSY (SUDEP)

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Introduction: Epilepsy is associated with a substantial risk of morbidity and mortality, including sudden unexplained death in epilepsy (SUDEP). Prior data demonstrated a possible association between obstructive sleep apnea (OSA) based on nocturnal oximetry oxyhemoglobin saturation index (ODI) and risk of SUDEP. We aimed to evaluate the relationship between PSG-defined OSA and SUDEP risk using the revised SUDEP Risk Inventory (rSUDEP-7).
Methods: We identified adults with epilepsy who underwent PSG between January 2004 and December 2016 at Cleveland Clinic. OSA was defined as an apnea-hypopnea index (AHI) ≥5 and moderate-to-severe OSA as an AHI ≥ 15. SUDEP risk was determined by the rSUDEP-7. The higher the rSUDEP-7 score, the greater the risk for SUDEP. Associations between rSUDEP-7 score and OSA groups (AHI>15 vs. <15) used Wilcoxon rank sum tests, and multivariable linear models adjusting for age, sex, BMI, and smoking status. Spearman correlations measured relationships between rSUDEP-7 score with AHI and ODI.
Results: 214 patients were identified; 134 (62.6%) had OSA, moderate-to-severe in 75 (35%). Those with AHI≥15 were older and more likely to have: pharmacoresistant epilepsy, nocturnal seizures, higher BMI, and longer epilepsy duration (all $p<0.05$). Median rSUDEP-7 score was 1(0,3), and > 35% had rSUDEP-7 score of > 3. Patients with moderate-to-severe OSA had higher rSUDEP-7 than those with AHI<15 ($p=0.001$). Higher AHI and ODI positively correlated with rSUDEP-7 ($p=0.002$ and $p=0.016$) while SpO2 nadir negatively correlated with rSUDEP-7 ($p=0.007$). After adjustment, those with AHI≥15 had mean rSUDEP-7 score 1.14 points (95%CI 0.55–1.72, $p<0.001$) higher than those with AHI<15.
Conclusion: Epilepsy patients with moderate-to-severe OSA, have higher risk of SUDEP based on the rSUDEP-7. Our findings provide further support for routine screening of OSA in epilepsy populations.
Support (if any):

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DIFFUSION TENSOR IMAGING AS A POTENTIAL BIOMARKER OF SLEEP DYSFUNCTION IN WARFIGHTERS WITH CHRONIC, SEVERE, TRAUMATIC BRAIN INJURY

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Introduction: Traumatic brain injury (TBI) plagues service members in times of war and training. Diagnosis and management of TBI remain challenging, with many suffering from sleep disorders. We hypothesized that TBI-related damage to the hypothalamus, a master regulator of breathing and sleep, could be related to post-TBI obstructive sleep apnea (OSA) and serve as a pathophysiological biomarker for a subpopulation of OSA patients.
Methods: This was a retrospective study of warfighters with TBI from the National Intrepid Center of Excellence (NICoE). Subjects were identified by severe TBI on neuroimaging and compared against a control group without TBI. All subjects underwent screening polysomnography (PSG). MRI was acquired via 3T scanner. The hypothalamus was automatically segmented using a diffeomorphic algorithm. DTI scalar values were analyzed with scalar t-tests between subjects and controls. Generalized linear modeling with DTI scalar values was used to predict AHI in subjects.
Results: 6 subjects and 61 controls were identified. There was significant sleep dysfunction amongst TBI subjects (mean apnea-hypopnea index (AHI) 5.1+/-6.6 events/hour; mild OSA incidence 33.3%; Pittsburgh Sleep Quality Index (PSQI) mean 13.3+/-2.6). Radial diffusivity (RD), axial diffusivity (AD) and mean diffusivity (MD) were significantly higher among subjects (control RD 9.64x10^-10+/-7.54x10^-11 m^2/s, subject RD 1.13x10^-9+/-1.20x10^-10m^2/s, p = 0.023; control AD 1.32x10^-9+/-7.64x10^-11m^2/s, subject AD 1.50x10^-9+/-1.43x10^-10m^2/s, p = 0.029; control MD 1.08x10^-9+/-7.43x10^-11m^2/s, subject MD 1.25x10^-9+/-1.34x10^-10m^2/s, p = 0.025). There were no differences in age or body-mass index. Generalized linear modeling with diffusivity measures as predictors of AHI in subjects was not significant.
Conclusion: Using a diffeomorphic algorithm to define the hypothalamus reveals significantly elevated scalar DTI measures in chronic, severe TBI compared to controls. DTI differences in the hypothalamus are a novel finding and possibly underlie part of the pathophysiology of TBI. Although this may have potential to serve as a biomarker in severe TBI patients with sleep disorders, these initial data do not support a relationship between DTI and AHI, despite high incidence of OSA and subjective sleep dysfunction. Future studies with more subjects may better elucidate the changes in hypothalamic DTI after TBI for clinical outcomes analysis.
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AUTOMATED DETECTION OF SLOW WAVE COHERENCE IN SLEEP EEG: A POTENTIAL NEUROPHYSIOLOGICAL CORRELATE OF COGNITIVE DECLINE

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Introduction: A bidirectional relationship exists between sleep disruption and neuropathology in Alzheimer's disease (AD). The sleep electroencephalogram (EEG) is a highly stereotyped, direct neurophysiological window into brain function; prior studies have identified abnormalities in EEG slow waves in early AD. EEG coherence across channels during sleep, a normally highly coherent brain state, could be an indicator of network coordination across brain regions. Accordingly, altered slow wave coherence during sleep may be an early indicator of cognitive decline.
Methods: EEG was collected during an attended overnight polysomnogram (PSG) from a community-based cohort of older subjects (n=44, average age = 71), approximately 25% of whom met criteria for mild cognitive impairment or early AD. Files were exported to EDF and a slow wave peak detector was implemented in MATLAB to count the number of slow wave oscillations, with automated artifact rejection, across 6 EEG leads standard for PSG (C3, C4, F3, F4, O1, and O2). Slow wave coherence was inferred when slow waves occurred in temporal synchrony across channels within 100 ms.
Results: Subjects with cognitive impairment showed significantly reduced total sleep time and time spent in rapid eye movement (REM) sleep compared to age-matched controls. EEG slow wave coherence was reliably quantified during wake, non-REM stages N1, N2, N3, and REM vigilance states as well as during transition periods between sleep stages. Using this algorithm, specific signatures of slow wave propagation during sleep were identified, including increased variability in slow wave activity and coherence, that appeared more prominent in subjects with impaired cognition.
Conclusion: EEG slow wave coherence during sleep and wake states can be calculated by applying automated algorithms to PSG data, and may be associated with cognitive impairment.
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SIMILARITIES OF SLEEP MACROSTRUCTURE IN COGNITIVELY NORMAL ELDERLY AND PATIENTS WITH TRAUMATIC BRAIN INJURY

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Introduction: The stability of sleep architecture and breathing across nights can depend on factors relating to the integrity of the nervous system. Traumatic brain injury (TBI) represents a sudden-onset dysfunction of the nervous system while normal aging is associated with more gradual changes to the nervous system. While normal aging and history of TBI are both associated with sleep complaints, less is known about the stability of sleep physiology variables in these populations. Therefore, the aims of our study are to determine which sleep variables have greater night-to-night stability in separate populations of individuals with TBI and in cognitively normal older individuals.
Methods: All volunteers completed 2 consecutive in-laboratory nocturnal polysomnograms (NPSG). The TBI sample (N=35) comprised 71% women and 26% men (average age of 47.3 years). The cognitively normal older sample (N=78) included 74% women and 25% men (average age of 66.4 years). Descriptive statistics and intra-class correlations (ICCs) were calculated for sleep macrostructure variables (total sleep time (TST), sleep efficiency (SE), arousal index (ArI), rapid eye movement (REM), non-REM 1 & 2 (N1, N2), slow-wave sleep (SWS)), and sleep apnea including stage-specific apneas (i.e., AHI4%, AHI3A).
Results: Among volunteers with TBI, ICCs for sleep architecture variables were: TST (0.68), SE (0.65), ArI (0.92), %SWS (0.77), %REM (0.50), %N1 (0.83), %N2 (0.62). ICC's for sleep apnea variables were: AHI4% (0.86), AHI3A (0.86), REM AHI4% (0.63), REM AHI3A (0.65). Among cognitively normal older volunteers, ICCs for sleep architecture variables were: TST (0.26), SE (0.29), ArI (0.80), %SWS (0.68), %REM (0.39), %N1 (0.66), %N2 (0.49).

ICC's for sleep apnea variables were: AHI4% (0.91), AHI3A (0.92), REM AHI4% (0.85), REM AHI3A (0.83). All ICCs were statistically significant in both groups, except for %N1 among cognitively normal older volunteers.

Conclusion: In both populations, ICC's for arousal index were greater than for TST or SE. Likewise, ICC's were higher in %SWS and %N1 than for %N2 or %REM. Breathing variables were more stable than architecture variables. REM-specific breathing variables showed comparatively less consistency, possibly the product of lower ICC's for %REM sleep versus other sleep stages.

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OBSTRUCTIVE SLEEP APNEA SYMPTOMS PREDICT COGNITIVE FUNCTION FOLLOWING MILD TRAUMATIC BRAIN INJURY

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Introduction: Sleep disturbances are commonly reported following mild traumatic brain injury (mTBI). Specifically, one of these disturbances is obstructive sleep apnea (OSA), which involves repeated episodes of reduced upper-airway flow during sleep. When compared to the general population, OSA is reported at a much higher rate among the mTBI population. However, little research has investigated the relationship between OSA and cognitive performance among the mTBI population. We predicted that in those who suffered a mTBI, symptoms of sleep apnea would be predictive lower cognitive processing.

Methods: We collected data from 37 healthy controls (Mean age = 24.3 □ 5.8) and 145 participants with mTBI (Mean age = 24.3 □ 6.8), ranging from 2 weeks to 12 months post-injury. Participants completed the Pittsburg Sleep Quality Index (PSQI) including questions indicative of OSA, such as "cannot breathe comfortably" and "cough or snore loudly" during sleep. We calculated the PSQI Sleep Disturbance (PSQI-SD) composite score, which ranged from 0 to 2. Participants completed the Automated Neuropsychological Assessment Metrics (ANAM4), a novel computer-based assessment, to measure reaction time (RT).

Results: When comparing the percentage of participants in each group endorsing sleep disturbances on the PSQI-SD, we found a significant difference in the proportion of individuals scoring a 2 on PSQI-SD between the groups (□2(2) = 13.55, p = .001). In healthy controls, 8% scored 0, 89% scored 1, and 3% scored 2 on the PSQI-SD. In contrast, following mTBI, 1.4% scored 0, 72.4% scored 1, and 26.2% scored 2 on the PSQI-SD. Furthermore, PSQI-SD significantly predicted RT (□ = .18, p = .03) in the mTBI group, a relationship not observed in the control group (□ = .30, p = .07).

Conclusion: mTBI increases the incidence of sleep disturbances and symptoms related to OSA. Furthermore, sleep disturbances and OSA-related symptoms were predictive of cognitive performance in individuals who sustained a mTBI, but not healthy controls. Increases in PSQI-SD scores were associated with increased RT, indicating greater deficits in cognitive function, specifically reaction time. These data provide evidence that higher severity in respiratory symptoms relating to sleep apnea hinders cognitive processing, particularly for individuals who have suffered a mTBI.

Support (if any):

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SEIZURE-ASSOCIATED CENTRAL RESPIRATORY EVENTS: WHAT'S SLEEP GO TO DO WITH IT?

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Introduction: Seizure-related respiratory dysfunction has been reported in patients with epilepsy(PWE) on scalp EEG. We assessed this in Stereo-EEG(SEEG) recordings in patients with pharmacoresistant focal epilepsy.

Methods: PWE undergoing SEEG wore temperature/pressure-based airflow,RIP belts, SpO2, and EtCO2/TcpCO2. Interpretable recordings required SpO2 and at least one airflow and effort channel. Respiratory events including apneas, hypopneas(3%) and central pauses (5 to<10sec). Respiratory events, respiratory rate(RR), SpO2 nadir, total desaturation time, Peak EtCO2/TcpCO2, and hypercapnia duration were analyzed surrounding seizures. Frequency and duration of central events were compared in sleep-onset and awake seizures. Linear mixed-effects models evaluated relationships between respiratory variables and the frequency and duration of central events associated with seizures and compared respiratory variables between seizures with and without events.

Results: 44 seizures were recorded in 23 patients. Seizures were focal-onset in 79.5%(n=35), GTC in 20.5%(9). Respiratory events accompanied 61.4%(27) of the seizures with median duration/seizure duration of 0.40(IQR: 0.27, 0.61). Of the 47 respiratory events, 42 were central events, and 66.6%(28) were central apneas. Respiratory events occurred during the seizure in 73.8%, postictal in 26.2%; median SpO2 nadir was 90%(77.0, 93.0), total desaturation duration 104.3(50.3, 195.0)sec, peak TcpCO2 41.3(38.7, 44.8) mmHg, hypercapnia duration 157.6(51.0, 367.9) sec, and ictal-postictal RR change 3.3 ± 4.0bpm. For every 1 sec duration increase in central event duration, there was a significant increase in peak TcpCO2 0.35(95%CI [0.09,0.62],p=0.015) and TcpCO2 change 0.25(95%CI [0.02,0.49],p=0.037). Presence of central events were associated with increased peak TcpCO2(9.82[3.77,15.9], p=0.006). Seizures with central events trended greater changes in RR, SpO2, and EtCO2/TcpCO2, desaturation and hypercapnia time, with negative changes in SpO2 nadir. No significant difference on central event frequency was found between sleep-onset and awake seizures.

Conclusion: Central events including apneas and pauses are common in focal seizures arising from sleep and wake and are associated with hypercapnia. In addition to the significant association between TcpCO2 and the frequency and duration of central events, there is a positive trend of association of other respiratory dysfunction parameters. These findings suggest that central events may lead to a cascade of respiratory disturbance that may participate in the pathophysiology of sudden unexplained death in epilepsy.

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SLEEP DISTURBANCES IN PATIENTS WITH FRONTOTEMPORAL DEMENTIA

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Introduction: Frontotemporal dementia (FTD) is a degenerative process and,as the name implies, involves the frontal and temporal lobes of the brain. Patients with FTD make up 10–15% of all cases of dementia and 20% diagnosed before age 65, however not much is reported about sleep disturbances in these patients. Given the area of neuronal loss one would expect that sleep may be influenced early and by issues in arousal mechanisms and in breathing pattern. This study examined the polysomnography (PSG) reports of patients with a diagnosis FTD.

Methods: A retrospective chart review was performed to identify patients with both a diagnosis of FTD and having undergone a PSG. 23 patients were identified as fulfilling both requirements. Data recorded included, diagnosis, age at time of PSG, Epworth sleepiness scale (ESS), total sleep time (TST), wake after sleep onset (WASO), sleep latency (SL), REM sleep latency, sleep efficiency (SE), percentage of stage N1, N2, N3, and REM sleep, apnea-hypopnea index (AHI), presence of Cheyne-Stoke breathing, periodic limb movement index, and presence of REM without atonia.

Results: Patient age ranged from 57–85 years. Average ESS was 8.8 with only 5 patients reported excessive daytime sleepiness(as assessed by ESS). The average TST was 290 minutes, average SL was 37.9 minutes, average WASO was 147.5 minutes, and average sleep efficiency was 60.3%. Patients spent the majority of time in N2 sleep with an average of 68.3% of the time spent in N2. The average time spent in N3 was 9.6% of sleep. 8.9% of sleep was spent in REM. 83% of patients were diagnosed with sleep apnea (as defined by an AHI > 5), with an average AHI of 20.2 events/hour. Cheyne-Stokes breathing was only noted in 4 of the 23 patients, or 17%. Periodic limb movements of sleep were noted in 48% of the patients (n=11). REM without atonia or RBD was not noted for any patients.

Conclusion: This study shows that patients with FTD suffer from typical sleep disturbances, however there is a high prevalence of sleep apnea as well as PLMS. In addition, patients with FTD have decreased sleep efficiency with increased WASO.

Support (if any):

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A MULTIDISCIPLINARY APPROACH TO INVESTIGATING SLEEP PRACTICES AND SLEEP DISTURBANCES ON AN INPATIENT NEUROLOGY UNIT

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Introduction: Minimizing nightly disruptions in the inpatient setting requires a multidisciplinary, collaborative approach. Our aim was to assess staff perceptions and practices of sleep during hospitalization to help identify and prioritize improvement initiatives.
Methods: An online survey was distributed to inpatient staff (nurses, residents, attendings, APPs) on a neurology unit at an academic medical center. The survey assessed sleep disturbances, sleep knowledge and sleep practices. Responses across groups were analyzed using Cochran Armitage tests. Cumulative logit model was also performed.
Results: Among the 49 respondents, 75% reported not having the training to diagnose and treat sleep disorders. 51.2% rarely or never asked about sleep quality or duration prior to admission. 29.6% rarely or never tracked the amount and quality of sleep during hospitalization. Reasons for not tracking or considering sleep included "not being a priority", "no place to document" and "not being there at night." Overall, staff ranked noise, testing and vital sign checks as most disruptive to sleep quality and temperature as least disruptive. However, nurses perceived medication administration (p=0.0001) and testing (p=0.0296) more disruptive than the ordering providers. Multivariable analysis showed nurses ranked medication administration higher than providers when shift differences were controlled (p< 0.01). Evening/night shift workers ranked pain (p=0.0324) and anxiety (p=0.0360) higher than day shift workers. Those comfortable with diagnosing and treating sleep disorders were more likely to track sleep during admission (p=0.009), allow patients to sleep during medication administration times (p=0.0189) and allow sleep during scheduled lab draws (p=0.0189).
Conclusion: Our findings indicate that differences in sleep knowledge and sleep perspectives exist across the healthcare team. Possible explanations include training differences, ordering providers not knowing what time medications are administered or when tests are done, teams not clarifying whether nighttime orders are critical and nurses lacking empowerment to notify providers that sleep is being disrupted. Hand offs may need optimization with regards to pain and anxiety. A multidisciplinary approach, particularly between providers/nurses and night/day teams is critical to improve sleep on inpatient units. Our next steps include surveying patients, tracking nightly disruptions using EMR and decreasing unnecessary overnight orders using a team based approach.
Support (if any):

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TOWARDS A MORE PERFECT UNION: INTERRATER RELIABILITY BETWEEN TELEMEDICINE AND IN-PERSON EVALUATORS IN SLEEP DISORDERED BREATHING

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Introduction: Telemedicine has rapidly changed the landscape of all of clinical practice, and is now widely employed in sleep medicine. To date, the accuracy of telemedicine in identifying patients at risk for obstructive sleep apnea (OSA) is still unknown. Given differences in technique and fidelity, a perfect correlation between these two types of encounters cannot be assumed. We studied how providers using a telemedicine platform compared to providers using traditional in-person encounters in identifying risk for sleep disordered breathing.
Methods: 90 participants referred to a comprehensive university sleep program were randomized to this interrater reliability study. Subjects were representative of the gender and ethnic breakdown of the outlying community. The subjects were evaluated by an in-person clinician investigator, then randomized to a second clinician investigator who performed an evaluation online using a common teleconferencing platform. Both types of evaluations included a history and physical exam. The primary outcome was pretest probability for obstructive sleep apnea. Secondary comparators included level of daytime sleepiness, snoring volume, apneas witnessed by a third party, modified Mallampati score, presence/absence of tonsils, degree of overjet bite, and severity of apnea based on home sleep testing.
Results: Interrater reliability for pretest probability of OSA was reflected in a weighted kappa value of 0.414 (SE 0.090, p=0.002). This suggests moderate agreement between the an in-person and telemedicine evaluator. Kappa values of our secondary outcomes ranged from -0.044 (degree of maxillary overjet) to 0.702 (apneas witnessed by a third party), and were generally higher for historical elements and lower for physical exam findings.
Conclusion: Evaluation for pretest probability for sleep apnea via telemedicine has a moderate interrater correlation with in-person assessment. A relatively high degree of interrater reliability for historical elements suggests that the accuracy of telemedicine for OSA is tempered by a suboptimal physical exam. Telemedicine evaluations might become more accurate through standardization. For instance, using validated scales for OSA or templated encounter scripts may help with risk-stratification, and ultimately lead to more uniform management.
Support (if any): This study was supported by an AASM Foundation Focused Project Award

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BARRIERS TO SCREENING AND DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA DURING INPATIENT TRAUMATIC BRAIN INJURY REHABILITATION

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Introduction: Obstructive Sleep Apnea (OSA) is prevalent after moderate to severe traumatic brain injury (TBI) and may diminish recovery when left untreated. Despite the demonstrated importance of treating OSA following TBI, assessment for OSA during or soon after inpatient rehabilitation for TBI is limited. Little is known about barriers to implementing OSA screening and early diagnosis during inpatient rehabilitation thus hindering the translation of evidence-based OSA assessment procedures into clinical practice and potentially delaying necessary OSA treatment. The current analysis explored facilitators and barriers to implementing OSA screening tools in an inpatient rehabilitation setting from the perspectives of end user stakeholders.
Methods: Patients, families, industry, clinical providers and administrators participated in a two-day meeting following completion of a diagnostic clinical trial of OSA screening and diagnostic tools during inpatient rehabilitation. Stakeholders were provided with open ended questions generated by study investigators and given the opportunity to

respond on paper or a "graffiti wall" (i.e., white board). Example questions include "What are the greatest needs of the healthcare system related to sleep apnea and TBI?" and "What are the key things we need to consider to move results into real-world practice?" Qualitative content analyses using a rapid matrix approach were conducted from stakeholder feedback obtained during the two-day meeting, which included a guided review of emerging OSA research and discussion of potential implementation barriers of OSA assessment during inpatient rehabilitation.
Results: Improved screening and treatment practices for OSA were the greatest needs identified. To meet these needs, stakeholders identified the importance of improving patient, family, and staff understanding of OSA (e.g., health literacy) and other sleep disorders through education; inpatient rehabilitation access to resources (technology; sleep providers); and reimbursement for additional inpatient procedures.
Conclusion: Although treatment of OSA is crucial for recovery during inpatient rehabilitation following TBI, barriers to earlier recognition, diagnosis, and treatment of OSA exists across several different domains, including education, resources, and funding policies. Findings support future implementation efforts to translate evidence-based care into practice to improve patient outcomes.
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DIAGNOSTIC PATHWAYS OF PATIENTS AUTHORIZED FOR OBSTRUCTIVE SLEEP APNEA TESTING AND TREATMENT: A RETROSPECTIVE CLAIMS ANALYSIS

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Introduction: Obstructive Sleep Apnea (OSA) has been shown to reduce health-related quality of life and is associated with cardiovascular disease and other negative health outcomes. However, many patients with suspected OSA are never tested, thereby remaining undiagnosed and untreated. In this study, we explore the diagnostic pathways and eventual treatment of individuals with suspected OSA.
Methods: We conducted a retrospective, observational study, linking claims and prior authorization data of a large, geographically diverse health insurer's commercial and Medicare Advantage members. Our sample included adults with suspected OSA and no prior OSA history, whose diagnostic testing had been approved through prior authorization (N=75,011). Using a 3-month time window following authorization, we searched for a claim to match the authorized service (home or laboratory sleep testing). We also looked for subsequent prior authorization for OSA treatment (Positive Airway Pressure (PAP) or oral appliance) and corresponding claims for those treatments within the 3-month authorization window.
Results: Among the study sample (N=75,011), 40,002 (53.3%) had home testing only, 17,319 (23.1%) had laboratory testing only, and 6,053 (8.1%) had a home test followed by a laboratory test. Only 476 (0.6%) had a home test after the date of a lab test. 11,161 individuals (14.9%) did not complete any sleep test. Of the 63,850 individuals with any sleep testing, 39,062 (61.2%) received prior authorization for initiating OSA treatment, and 36,158 (92.6%) of them had a corresponding claim for treatment.
Conclusion: One in eight adults with suspected OSA for whom diagnostic testing was authorized did not undergo testing; among those who tested, home testing was most common. While it is clinically appropriate to follow a negative home test with a lab test since a home test cannot rule out OSA (only confirm it), the study notes that a significant number of those with a home test require follow-up laboratory testing. Together, this represents an opportunity for reducing barriers to testing and improvement in home testing technology.
Support (if any): This study was funded by Anthem, Inc.

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SLEEP AND FATIGUE MITIGATION: PAVING THE WAY FOR TRAINING HEALTH CARE TRAINEES

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Introduction: The health care workforce is undoubtedly prone to fatigue and sleep deprivation due to extensive hours, shift work and intense demands of the training. The physical and behavioral effects of sleep deprivation can compromise well being and also negatively impact clinical performance. ACGME has been actively engaged in efforts to promote protection of health care trainees from the deleterious effects of sleep deprivation but the grass root level educational efforts towards teaching trainees to mitigate sleep deprivation are lacking.
Methods: We conducted a 60 minute long "Sleep and Fatigue Training Session" with the goals of increasing the understanding of effects of sleep deprivation and training in countermeasures. The session was conducted as a part of the annual GME orientation session for all the incoming learners. 274 trainees (residents & fellows) participating from all the departments were divided into 25 small groups of 7–12 members each. Clinical vignettes, brief presentation and moderator facilitated interactive discussion were utilized as teaching tools. Handouts with strategies and resources for the trainees were disseminated. Pre and post session surveys were designed to assess trainees baseline understanding of sleep impairment, impact on performance, recognition of impact, possible countermeasures and the impact of module on the aforementioned parameters after the intervention.
Results: Based on the cumulative trend of participant's responses obtained on a Likert scale of 1 to 5, results showed improvement in all the parameters including access to training (3.67 to 4.44), awareness (4.31 to 4.46), recognition (4.04 to 4.36), strategies (3.6 to 4.36), and resource availability (3.24 to 4.33). Attendees reported a cumulative score of 4.23/5 in terms of beneficial impact of the module. The resource availability parameter demonstrated the highest average increase (33.6%) after the intervention. The lowest increase in the cumulative trend was displayed (3.5%) in the self-awareness parameter.
Conclusion: The feedback from learners demonstrated that the interactive model of sleep training session was very favorably received with improved scores in all the parameters assessed. Our model paves the way for other institutes to adopt similar training sessions for learners.
Support (if any):

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INNOVATIVE ELECTRONIC SLEEP MITIGATION TOOL FOR MEDICAL TRAINEES.

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Introduction: The ACGME (Accreditation Council for Graduate Medical Education) has been advocating for training of medical learners in sleep and fatigue mitigation, in attempt to enhance their wellbeing. While some educational programs include a one-time sleep didactic, prone to being overlooked, there is need for an educational resource which can be accessible to the learners throughout their training span. The trainees' needs and readiness to learn may vary from time to

time, therefore, continued access to educational resources can be very beneficial.

Methods: An electronic tool was created on Coggle, comprising of educational resources and content on the basic tenets of sleep quality, regulation, effects of deprivation and strategies to mitigate these effects. Links to free resources made available by AASM, such as "Choose Sleep," were also included. The sleep resources were then incorporated in the overall continuum of Graduate Medical Education (GME) resources available to trainees, and was advertised in newsletters, incorporated in orientations (n=324) and wellness sessions (n=254). The GME Institutional Quality of Life data was obtained in 2018–2019 and in 2020 to ascertain baseline and post-intervention measures of wellness, workload and burn-out in trainees.

Results: Data collected in 2020, after introduction of Coggle, demonstrated: 1) A 4% increase of residents (n=1041) would rate their workload as "just right." 2) A 9% increase of residents (n=1040) said their personal health and wellbeing was "very good" and "good." 3) A 12% decrease of residents (n=1040) said they felt burned out at work. 4) A 5% decrease of residents (n=1037) said they felt they had become more calloused towards people since they first started training.

Conclusion: The analysis of learners' feedback demonstrated that access to sleep training resources on a continuous, on-demand basis improved trainees' personal health and wellbeing. The positive impact was sustained despite unprecedented stress caused by the COVID-19 pandemic. Future steps include: 1) Moving the electronic tool to a more advanced platform with analytical capabilities. 2) Obtaining longitudinal data to assess the impact of the electronic tool on medical trainees' sleep parameters. 3) Sharing the electronic tool with other organizations to improve wellbeing of all medical trainees and health professionals.

Support (if any):

810

HOW MUCH DOES IT REALLY COST? BARRIERS, BOTTLENECKS AND BILLING IN SLEEP DIAGNOSTICS

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Introduction: Utilization rates of home sleep apnea tests (HSATs) versus in-lab polysomnograms (PSGs) vary greatly among healthcare institutions. HSATs can provide expanded testing capacity and offload operational bottlenecks in sleep labs, however, the financial benefit of this is not well quantified. Comparison of testing utilization and profitability between institutions can provide greater insight into decisions regarding sleep lab operations and expansion.

Methods: We analyzed profitability of HSATs and PSGs in 2018–2019 at two separate institutions with vastly different operational constraints and healthcare delivery models: Greater Los Angeles VA Healthcare System (GLA-VAHS) and University of California Los Angeles Health System (UCLA-HS). Both institutions own and operate independent sleep labs and offer HSATs for the diagnosis of sleep apnea. Profitability was calculated using contribution margin (CM) which factors out high fixed costs of healthcare infrastructure. CM was calculated by subtracting variable direct costs from revenue.

Results: The non-diagnostic HSAT rate was higher at GLA-VAHS compared to UCLA-HS (30.5% versus 13.1%). At both GLA-VAHS and UCLA-HS, HSATs were more profitable than PSGs on a per-unit basis (CM 47% for HSATs and 29% for PSGs at GLA-VAHS vs. 78% and 66% at UCLA-HS, respectively). Comparing the two institutions, PSGs were 14.8 times more profitable and HSATs were two times more profitable at UCLA-HS versus GLA-VAHS. When analyzed on a per-day basis, HSATs were more profitable at GLA-VAHS but PSGs were more profitable at UCLA-HS.

Conclusion: Reimbursement rates significantly impact institutional decisions to expand utilization of HSATs versus PSGs. Due to higher per-unit reimbursement rates, non-governmental and larger academic institutions may opt to aggressively expand sleep lab capacity. However, risks and benefits of such a strategy should be taken into account in light of changing market patterns and declining reimbursement rates for PSGs. Despite the seemingly higher profitability at the current time, future market volatility in PSG profitability may cause delayed amortization of costs for PSGs at large academic and private institutions compared to the relatively lower cost of expanding HSAT capacity. It may be beneficial for all types of institutions, regardless of current reimbursement rates, to expand HSAT capacity concomitantly with sleep lab expansion to mitigate financial risk.

Support (if any):

811

LESSONS FROM A PANDEMIC - STREAMLINING SLEEP APNEA CARE; IS THE FUTURE HERE?

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Introduction: Ready access to optimal care for sleep-related breathing disorders (SRBD) remains a major barrier to the vast majority of an estimated 25 million Americans with undiagnosed obstructive sleep apnea. This barrier includes lack of readily available sleep medicine expert contact, health care insurance navigation challenges and difficulties with continuity of care. Chronic pervasive gaps in sleep medicine care were exacerbated by the COVID-19 pandemic in 2020. While numerous models were previously proposed to bridge SRBD care gaps, sustained and quantifiable success has been elusive.

Methods: Deploying interactive technology and artificial intelligence, we designed and implemented a novel, user-friendly integrated medium named Ognomy - the Sleep Apnea App, to mitigate widespread SRBD care access gaps. Multi-faceted but unified open access was made widely available, allowing bidirectional patient-provider interaction through a Web App. Individuals or surrogates who suspect that they or dependents suffer from SRBD are able to readily establish secure access to Ognomy. Patients can independently download and interact with the application on-demand and around the clock.

Results: From April 2020 to date, more than seven thousand (7,726) Ognomy App downloads have been documented. Over a thousand (1,169) patient registrations have occurred on Ognomy. Five hundred seventy-four (49.1%) of Ognomy App registrants have since been provided hitherto difficult, cumbersome access to full care, by a board-certified Sleep Medicine provider. Four hundred eighty-nine (85.2%) of the 574 patients managed via Ognomy's care provision chain proceeded to complete sleep diagnostic testing and follow up.

Conclusion: Availability of a readily accessible and affordable multi-faceted platform for care of sleep-related breathing disorders will mitigate the burden of untreated SRBD in the United Sates and worldwide. Ognomy, a Sleep as a Software service, is a novel integrated tool, bridging chronic gaps in sleep apnea care. Measures that significantly alter the trajectory of Sleep Medicine care now and in the future, have the potential to systematically close existing SRBD care gaps worldwide. Innovative tools such as algorithmic scheduling, Blockchain utility for platform interoperability, facilitating insurance benefit verifications, deployed in tandem with delivery drone systems for home sleep testing, should enhance turnaround time and improve care currently available for SRBD.

Support (if any):

812

COMPETENCY BASED GOALS FOR SLEEP MEDICINE CURRICULUM IN UNDERGRADUATE MEDICAL EDUCATION IN INDIA: A SURVEY

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Introduction: Sleep is recognized the world over as very important in health and disease. But there is no articulated curriculum in undergraduate (UG) medical education in India. Whence incorporated, these learning objectives serve as an important bridge across multiple medical faculties like pulmonary medicine, neurology, ENT, psychiatry, and basic sciences.

Methods: After obtaining informed consent, a questionnaire-based electronic survey was circulated to clinical/non-clinical teaching medical faculties in December 2020. They were asked to prioritize the objectives of the sleep medicine curriculum for the UG medical education program. The objectives were listed under knowledge and skill-based competencies each having 9 and 10 questions respectively, scale rated 1–5. Objectives were enlisted from the previous studies, consensus statements and modified according to the local needs after face to face meetings with faculties involved in UG curriculum development.

Results: Out of 400 faculty members from different medical schools all over India, 127 had responded. None of the Indian institutions had sleep medicine in their UG curriculum. 112 (88%) members showed their interest to begin a UG program. The suggested sleep medicine curriculum proposes a vertical integration of competency-based goals into the core curriculum with a clinical angle which will require skill and knowledge-oriented modules. Amongst the knowledge-based competency, sleep loss and its health effects (77%) was more preferred than distinguishing sleep in newborns and adults (36%). Whereas in the skill-based competency providing advice on sleep hygiene (71%) was more preferred than sleep disturbances during pregnancy and menopause (33%). When our curriculum gets implemented, it is possible to provide exposure to sleep-related disorders early on for the UG's. This will invoke their interest and thus serve to bridge the lacunae caused by the shortage of trained sleep specialists in India.

Conclusion: From our study, the learning objectives of the sleep medicine curriculum have been prioritized and are ready for implementation. The survey has also created awareness and interest amongst the Indian medical teaching faculty.

Support (if any):

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PATIENT AND PROVIDER EXPERIENCES WITH CBT-I ADMINISTERED IN-PERSON OR VIA TELEMEDICINE

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Introduction: CBT-I is the gold standard treatment for insomnia, but access to in-person care is limited, which has worsened due to the recent COVID-19 pandemic. While providers across spheres of care have rapidly pivoted to telehealth there have been few systematic comparisons of in-person treatments to telemedicine approaches. The current study, launched pre-COVID, aimed to examine the perspectives of patients who were randomly assigned to receive CBT-I in-person or via telemedicine. Additionally, provider reflections were collected.

Methods: Individuals with DSM5 Insomnia Disorder (n=60) were randomized to in-person CBT-I, telemedicine CBT-I or a wait-list control group. CBT-I was delivered over 6–8 weekly sessions by video telemedicine or in-person. This nested qualitative study addressed patient and provider perspectives on treatment approaches. A sample of participants from each group (n=36) were interviewed 3 months post-treatment. Phone interviews were audio recorded, transcribed and analyzed using a directed content analysis approach. Results were organized into thematic categories including 1) participant experience with CBT-I, 2) access issues and 3) accountability issues related to delivery approach. Additionally, participating providers (n=7) were interviewed and shared their reflections on delivering CBT-I in-person vs. telemedicine.

Results: Patients reflected positively on CBT-I, and this did not vary across treatment groups. Patients and providers noted telemedicine benefits related to access that included, but were not limited to, reducing transportation barriers to treatment and improved continuity of care (e.g. not having to cancel an appointment if a patient was traveling). Patients and providers shared concerns they had anticipated pre-treatment about possible telemedicine related technological hurdles and barriers to establishing meaningful rapport on-line. However, they reported that these concerns did not prove to be barriers to effective telemedicine visits.

Conclusion: This qualitative study allowed patients and their providers to reflect on their experience delivering in-person vs telemedicine CBT-I. CBT-I was accepted well regardless of delivery approach. Telemedicine is currently being deployed widely and this study provides a systematic comparison between approaches.

Support (if any): This study was supported by the American Sleep Medicine Foundation.

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VHA'S TELESLEEP PROGRAM IMPROVES RURAL VETERAN ACCESS TO SLEEP CARE THROUGH EXPANSION OF TELEHEALTH NETWORKS

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Introduction: Rurality is a known contributor to health disparities, including Sleep medicine. Over 1 million (>350,000 rural, >650,000 non-rural) Veterans who received care from VHA in 2020 have obstructive sleep apnea (OSA). VHA's Office of Rural Health (ORH) TeleSleep Program (FY17-20) aimed to increase access to sleep care for rural veterans by establishing telehealth services at 12 hubs and 63 spokes across the country. The TeleSleep program has three components: (1) Telemedicine; (2) Home Sleep Apnea Testing (HSAT); and (3) REVAMP (Remote Veterans Apnea Management Platform), a web-application for comprehensive sleep apnea care.

Methods: Each of the three TeleSleep components was evaluated independently using specific metrics. We report here on the impact of leveraging telemedicine to improve access to sleep care. Patient care encounters are defined by VA-specific stop codes and are thus identifiable as telehealth or in-person visits. Data used in the evaluation were obtained from the VA Corporate Data Warehouse.
Results: During FY20, 33,743 rural Veterans had 74,458 sleep encounters within the TeleSleep network. Visits included in-person care, virtual initial and follow up visits, electronic consultations, asynchronous telehealth (remote monitoring of PAP data and HSAT), remote PAP initiation by video or phone, and email exchanges between patients and providers. Between FY17-20, the number of rural Veterans seen for sleep-related disorders at TeleSleep sites tripled (from 10,702 to 33,743), and the number of encounters for sleep-related disorders more than doubled (from 32,894 to 74,458). In FY20, 72% (up from 53% in FY18) of rural Veterans at the TeleSleep hubs or spokes had at least one virtual sleep visit. This was significantly higher than non-TeleSleep VA sites where only 64% of rural Veterans had virtual visits (72% vs. 64%; $p<0.001$). In addition, the proportion of Veterans who had face-to-face only visits (28% at TeleSleep sites vs. 36% at non-TeleSleep sites; $p<0.001$) indicates that the TeleSleep program was highly successful in promoting virtual (instead of face-to-face) visits.
Conclusion: The ORH TeleSleep Program has improved access to comprehensive sleep care for rural Veterans by increasing the proportion and type of sleep visits conducted virtually vs. in person.
Support (if any): Funding provided by VHA Office of Rural Health

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AUSTRALIAN SURGERY TRAINEE EDUCATION FOR CONTEMPORARY AIRWAY MANAGEMENT OF OSA: A PILOT RANDOMISED CONTROLLED STUDY

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Introduction: In Australia, ASOHNS delivers no formal curriculum for training of OHNS, or levels of competency required, to assess and treat complex OSA patients. Australian OHNS trainee confidence, knowledge and exposure to complex multi-level OSA surgery is lacking. Lack of exposure to sufficient complex OSA surgery case load has been identified as a major weakness in training within a recently published international survey. This study was a randomized clinical trial evaluating the effect of Australian OHNS trainee exposure to education materials compared with no exposure, on Sleep Surgery specific examination performance (multiple choice and short written answer).
Methods: 70 accredited and 45 unaccredited OHNS trainees were invited to participate in this trial. Participants were randomly assigned to Sleep Surgery educational material exposure or no exposure to those materials. Those randomized to the exposure group were provided educational material and were given 2 weeks exposure time prior to the exam. Each participant then complete an online examin, consisting of 40 multiple choice questions and 1 short answer question (marked by a field expert). Differences between exposure and control group means were tested using independent t-tests.
Results: 24 trainees were allocated to exposure and 22 to control. 33 participants attempted the examination. The were no significant differences between groups in the multiple choice (mean difference 1.3 ± 1.6 [3.3%], $p=0.41$) or written exam test scores (mean difference 1.8 ± 1.2 [9.0%], $p=0.14$). Accredited trainees performed better in the written exam (mean difference 2.6 ± 1.1 [13.0%], $p=0.03$). The mean test score in a separate exploratory group of 2 sleep fellowship trained OHNS was considerably higher in both exams.
Conclusion: This study suggests that exposure to formal education material may improve understanding of sleep surgery. Accredited trainees performed better than unaccredited trainees but the difference was small. Poor test performance in both groups may indicate further formal sleep surgery teaching is required in the ASOHNS training curriculum. Further research is required to identify the best ways possible to educate OHNS trainees in the complex and nuanced decision making required for OSA patients.
Support (if any): Illawarra Health and Medical Research Institute Grant 2019.

816

A CASE OF OBSTRUCTIVE SLEEP APNEA IN AN ADOLESCENT GIRL WITH CROUZON SYNDROME

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Introduction: Crouzon syndrome is an autosomal dominant type of craniosynostosis, first reported by French neurologist Octave Crouzon in 1912. Craniosynostosis refers to the premature closure of cranial sutures. The orofacial manifestations of this syndrome includes maxillary hypoplasia, external nasal deformity and prognathism, which can all contribute to breathing difficulties. The prevalence of Obstructive Sleep Apnea (OSA) is above 60%. The severity of obstruction can be life threatening prompting early surgical intervention ranging from tracheostomy to mid facial distraction like LeFort III osteotomy.
Report of case(s): An 18-year-old girl with Crouzon syndrome, who was referred for snoring. She had a significant past surgical history of craniotomy and ventricular-peritoneal shunt at the age of 2 years, tracheostomy dependency until the age of 5 years after undergoing a LeFort III osteotomy, and adeno-tonsillectomy at 6 years. She had never had a polysomnography (PSG) before. Her in-lab PSG showed moderate to severe OSA with an Apnea-Hypopnea Index (AHI) of 28.5/hr. She had no central apneas. Obstructive events were not controlled with Continuous Positive Airway Pressure (CPAP), but did respond to Bi-level therapy. Plastic Surgery favored a repeat LeFort III osteotomy and cranioplasty instead. A post-surgical PSG showed resolution of OSA with an AHI of 2.8/hr.
Conclusion: This case reminds us that patients with craniofacial abnormalities are at higher risk for OSA and are more difficult to treat. Our patient had significant sleep apnea despite prior surgical interventions. Patients with Crouzon syndrome should be studied for OSA, and re-assessed over time. Her repeat surgery had a positive outcome, and avoided PAP therapy. Therefore, Plastic Surgery should always be part of the therapeutic discussion.
Support (if any): 1. Samuel N, Arvind B, Sameep K and Eugene M (2014) Revisiting Crouzon syndrome: reviewing the background and management of a multifaceted disease. 2. J Sirotnak 1, L Brodsky, M Pizzuto (1995) Airway obstruction in the Crouzon syndrome: case report and review of the literature. 3. Mitsukawa N, Satoh K, Hayashi T, Furukawa Y, Uemura T (2004) A reflectable case of obstructive sleep apnea in an infant with Crouzon syndrome.

817

A CASE OF PARASOMNIA OVERLAP DISORDER IN A PATIENT ON LITHIUM

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Introduction: The literature contains few case reports of parasomnia overlap disorder. There are also few case reports of lithium inducing sleep walking behaviors. Here we seek to present a case of a patient with multiple parasomnias, is taking a number of psychotropic medications for bipolar I disorder, and is on PAP for OSA.
Report of case(s): The patient is a 43 year old male with a history of occasional mild sleep walking since childhood that remitted approximately 10 years prior to the onset of treatment, but returned when he traveled out of area for a family gathering approximately one year prior to presentation in the sleep clinic. He reported not only the return of sleepwalking, on a nightly basis, as well as more severe symptoms (including enuresis and violence/aggression). He also reported several episodes of dream enactment, as well as a history of sleep paralysis and vivid hypnogogic hallucinations, both of which had been improved in the last year. He denied any history of cataplexy. He did complain of symptoms of significant RLS symptoms. He was partially compliant with CPAP for obstructive sleep apnea, though the sleep behaviors continued regardless of CPAP usage. His psychiatrist had started him on clonazepam (titrated to 2mg/night) prior to his intake in the sleep clinic, but with minimal benefit. His other medications included propranolol 40mg BID, lithium 900mg/1200mg, oxcarbazepine 600mg bid, lamictal 225mg bid, lurasidone 80mg qday, and benztropine 2mg bid. Attended polysomnography demonstrated five episodes of sleep behaviors, as well as loss of atonia during REM, and severe obstructive sleep apnea (AHI of 61.2).
Conclusion: The patients various parasomnias could be due to the side effects of his psychotropic medications, represent a genetic or structural defect that is causing the various parasomnias, or be due to or worsened by his undertreated obstructive sleep apneas. His workup and treatment is still ongoing, but he has continued on clonazepam 2mg but taken 2 hours earlier, and has started a new APAP. Because of the severity of his bipolar disorder (including severe suicidal ideation), he is not a candidate to tapering the lithium or to taking serotonergic antidepressants.
Support (if any):

818

A GHOST FROM THE PAST: UNMASKED INSOMNIA AFFECTING HYPOGLOSSAL NERVE STIMULATION THERAPY ADHERENCE

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Introduction: Hypoglossal nerve stimulation (HNS) is an efficacious option for treating moderate to severe obstructive sleep apnea (OSA). However, there is sparse evidence regarding tolerance and adherence to HNS therapy in patients with a diagnosis of insomnia.
Report of case(s): A 57-year-old man with well-controlled depression presented for evaluation for HNS therapy. He had been diagnosed with moderate OSA with an apnea-hypopnea index of 22/hour, intolerant of continuous positive airway pressure and mandibular advancement device. He underwent uvulopalatopharyngoplasty without significant improvement. At the time of initial evaluation, he denied history of insomnia and prior sleep aid use. He subsequently underwent successful HNS device implantation and activation. One week after HNS initiation, the patient reported new symptoms of significant difficulty with sleep onset and inability to fall back asleep, which was worse than his untreated OSA symptoms. Device interrogation did not reveal any hardware problems. Adjustments to start delay, pause time and device configuration with awake endoscopy did not improve tolerance. Subsequently, the patient disclosed a remote history of insomnia, which was treated with multiple hypnotics in addition to cognitive-behavioral therapy for insomnia (CBTi) and had resolved. He was diagnosed with recurrent chronic insomnia, for which eszopiclone was initiated without significant improvement. He eventually agreed to CBTi, with partial improvement in device tolerance and improvement in insomnia symptoms.
Conclusion: This case highlights that HNS therapy adherence can be affected by prior history of, or a current diagnosis of insomnia. Our patient had a predisposition for insomnia that was well controlled prior to HNS therapy initiation. The onset of recurrent insomnia with HNS activation suggests that HNS was a precipitating factor for his now chronic insomnia. Although there is insufficient evidence to suggest whether history of insomnia should affect the decision to initiate HNS therapy, this case illustrates the importance of screening for insomnia

at pre-implant evaluation. Our center is now routinely screening for a history of insomnia to identify patients who may benefit from treatment prior to HNS implantation. Larger studies are needed to explore a possible relationship between insomnia and HNS adherence.
Support (if any):

819

A RARE CASE OF RESPIRATORY SENSE LEAD DYSFUNCTION IN A PATIENT WITH A HYPOGLOSSAL NERVE STIMULATOR

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Introduction: In patients with moderate to severe obstructive sleep apnea (OSA) who are intolerant to PAP therapy, hypoglossal nerve stimulation (HGNS) is being increasingly considered as alternative treatment. Implantation involves placing cuff electrodes on inclusion branches of the hypoglossal nerve and a respiratory effort-sensing lead which is placed between the right intercostal muscle layers. These are connected to the implantable pulse generator which usually sits in a right infraclavicular pocket.
Report of case(s): A 49-year-old male with severe OSA (AHI 30.8/hour) was implanted with a HGNS two years ago with successful activation a month later. He successfully up titrated his amplitude to the maximum stimulation level within his set range (0.9v – 1.7v). He underwent HGNS titration with AHI reduction to 13.9/hour at 2.1 volts and given a new higher range of 1.5 to 2.5 volts. This was accompanied by reduction in snoring, witnessed apneas and associated arousals with more consolidated sleep and improvement in his Epworth sleepiness score to 3 from 12 as noted prior to HGNS. The patient continued to up titrate over the next six months within his new range to 2.4 volts, when he reported increased sensitivity and intolerance at every stimulation level with recurrence of snoring and daytime sleepiness. He underwent interrogation of his device with subsequent awake endoscopy and change to his electrode configuration with a new lower range of 1.0 to 2.0 volts. However, he continued to have the same complaints. A second interrogation revealed increased impedance within the circuit of the respiratory sensing lead which was reproducible. The patient underwent sensing lead replacement in the operating room. He has since been able to increase stimulation levels without complaints and improvement in his OSA symptoms and is scheduled to have a follow-up hone sleep test (HST).
Conclusion: This case illustrates the importance of a structured approach in the evaluation of a reduced tolerance to HGNS. This includes assessing adherence, interrogation of the device's circuitry, evaluating electrode configurations, stimulation thresholds with consideration for awake endoscopy. Repeating this process may be necessary to detect rare or delayed mechanical problems that may occur over time with HGNS.
Support (if any):

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AN UNUSUAL CASE OF POST-TRAUMATIC BRAIN INJURY KLEINE-LEVIN SYNDROME WITH ANTI-GAD-65 AUTOANTIBODIES

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Introduction: Kleine-Levin Syndrome (KLS) is a rare clinical syndrome, and is precipitated by traumatic brain injury (TBI) in 9% of cases. An autoimmune component to KLS has previously been suggested. Autoantibody profiles in KLS are diverse and its overlap with autoimmune encephalitis is still not well described or understood. Here, a case of KLS in a patient with autoimmune diabetes with very high levels of serum autoimmune GAD-65 antibodies is presented.
Report of case(s): A 36-year-old male Veteran with a history of alpha-thalassemia minor, prior history of insomnia with nightly sleep of 6 hours, prior history of mild OSA with AHI of 5.8 on PSG in 2018, sustained a mild TBI on 11/13/2019 after a 50-pound box fell on his head. CT head and cervical spine were normal. One week later, he developed recurrent episodes of hypersomnia, sleeping up to 80 hours continuously, waking briefly only to urinate or eat, with hyperphagia, irritability, and derealization present during episodes. One month after the TBI, he was diagnosed with Latent Autoimmune Diabetes in Adults (LADA) after blood glucose was found to be elevated at 566. Serum GAD-65 antibody level was very elevated at 10,594 U/mL (ref range: 0–5 U/mL), hemoglobin a1c was 7.7%, and insulin was started. Six months later, he was evaluated in the VA Sleep Clinic for continued hypersomnia, despite controlled diabetes. Neurological examination, MRI brain, and sleep-deprived EEG were normal. Cerebrospinal fluid testing was normal, with the exception of a CSF autoimmune encephalitis panel with a positive GAD-65 titer of 0.24 nmol/L (range <0.02 nmol/L) – non-diagnostic for autoimmune encephalitis. HLA-DQ1B status is pending.
Conclusion: Autoimmunity is an emerging topic of clinical significance in KLS. GAD-65 serum antibodies have both endocrine and neurologic significance, with high levels seen in autoimmune diabetes, encephalitis, stiff-person syndrome, and cerebellar ataxia. An autoantibody panel can be considered in patients with KLS, as the presence of autoimmune encephalitis may support the use of immunotherapy.
Support (if any): Portland VA Research Foundation to Dr. Lim. The contents do not represent the views of the United States Government.

821

AN UNUSUAL PEDIATRIC PAP COMPLIANCE OBSTACLE, EVEN WHEN THE MASK FITS

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Introduction: Proper mask fitting is an important factor for compliant and effective use of PAP therapy. However, we present 2 patients whose masks became a barrier to PAP therapy despite a well-fitting mask.
Report of case(s): Case 1 A 12-year-old female with ADHD, Chiari I malformation status-post decompression, and persistent mixed central and obstructive sleep apnea is managed with BPAP S/T. Despite absence of upper airway structural abnormalities, she is a mouth-breather during sleep and only tolerates full face masks. Despite ensuring a good mask fit and optimal BPAP settings to control her AHI, she sleeps with her neck hyperextended, resulting in her lower jaw pushing caudally and the mask liner slipping into her mouth. This stimulated chewing and resulted in damage to several masks. Case 2 An 8-year-old male with congenital central hypoventilation syndrome is managed with BPAP S/T during sleep. Similar to case 1, he is a mouth-breather during sleep and can only tolerate full face masks. Although his mask and headgear fit him well, he drools in sleep which results in the silicone liner slipping into his mouth, stimulating chewing. This has led to the need for replacement of several masks. Of note, drooling did not occur when he was previously using assisted ventilation via tracheostomy, and bruxism was not identified during polysomnography.

Conclusion: To our knowledge, this is the first report of PAP mask chewing, thus its incidence is unknown. We suspect that the mask liner slipping into the mouth touches the anterior surfaces of the teeth stimulating the chewing reflex. The frequency of mask chewing and consequent damage is unpredictable and often necessitates mask replacement. Insurance companies should consider this unique mask complication when determining their mask coverage policies since the typical 6-months interval for authorization of a new mask can impair the patient's health, PAP compliance, and become an out-of-pocket financial burden for families. Although it did not occur in our patients, mask chewing may pose a potential choking hazard. Awareness of mask chewing may help in improving pediatric PAP mask development to ensure masks are safe.
Support (if any):

822

APNEA EVERY 5 MINUTES

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Introduction: Vagal Nerve Stimulators (VNS) are used in refractory epilepsy and depression. VNS are known to decrease airflow, oxygen saturation, and respiratory amplitude during sleep. We present a case of VNS induced OSA that was overlooked for 6 years.
Report of case(s): A 63-year-old Caucasian female with refractory depression, hypothyroidism, and obesity presented with snoring and excessive daytime sleepiness (EDS). She had VNS implanted in a research trial for depression. She was on bupropion, duloxetine, lithium carbonate, lamotrigine, olanzapine, and levothyroxine. Polysomnography (PSG) showed moderate OSA with apnea-hypopnea index (AHI) of 25.8 and SpO2 nadir of 83%, and was titrated to bi-level positive airway pressure (PAP). She tried different masks and pressures but her leak and PAP intolerance persisted. There was no improvement in her EDS, and Armodafinil was prescribed for wake promotion. She struggled with bi-level PAP therapy for five years before being considered for hypoglossal nerve stimulator. But was turned down because of VNS presence. She was then recommended maxillomandibular advancement (MMA) but decided against it. She continued PAP therapy until a repeat PSG revealed mild to moderate OSA (AHI 10.9, RDI 17.8, and SpO2 nadir 79%), and it was noted that most of her respiratory events appeared in a regular fashion at 300-second intervals corresponding with the firing of VNS. PSG performed with VNS turned off showed no OSA (AHI 0.8 and SpO2 nadir 85%). PAP therapy was discontinued and subsequent nocturnal pulse oximetry showed normal oxygenation (ODI 15, RDI 17.8, SpO2 <88% for only 1.7 minutes). Her EDS resolved and VNS was eventually removed as per patient's preference. She was started on a new medical therapy for depression. She continues to be asymptomatic.
Conclusion: Ascertainment bias led to delay in recognition of the cause of OSA as focus was on treatment only. Lowering the VNS frequency, increasing cycle time, turning it off during sleep or removal can improve respiratory events. The decision to do so depends on perceived benefit and harm of continuing VNS therapy. This case highlights the importance of re-evaluation of causes and treatment strategies when the standard of care is ineffective.
Support (if any):

823

APPARENT SEIZURE ACTIVITY IN A 9 YEAR OLD FEMALE PRESENTING AS HYPNOPOMPIC HALLUCINATIONS.

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Introduction: The presence of hypnopompic hallucinations raises concerns for narcolepsy. However, sleep-related hallucinations may occur in other settings. Dreams at sleep-wake transitions may be difficult for patients to differentiate from sleep-related hallucinations. Sleep-related hallucinations are predominantly visual, although they can be auditory, tactile and/or kinetic. However, they are generally not olfactory in nature.
Report of case(s): Here we present a case of a 9-year-old female with a history of tonsillectomy and adenoidectomy, ADHD, ODD, nocturnal enuresis, nocturia, aggressive behaviors and emotional outbursts who presented with EDS, frequent nocturnal awakenings, involuntary dozing, prolonged naps and a one year duration of hypnopompic hallucinations. Initially, the hallucinations occurred 2–3 times per week, but then decreased in frequency to 2–3 times per month. The frequency of episodes apparently decreased after tonsillectomy. She states that she wakes up and sees dots, and "she looks scary" when she looks at herself. She describes a variety of hallucinations including: seeing dots (including her mother being covered in dots), a cupcake, a strange woman walking, her hands looking strange--they had enlarged or hearing noises (a single loud bang). Pertinent physical exam findings included: BMI 66th percentile, Mallampati score 2/4, and a mildly enlarged tongue. The polysomnogram demonstrated mild obstructive sleep apnea by pediatric criteria, and, most notably, demonstrated an EEG with spike and wave formations in the central and frontal leads bilaterally. These were seen during NREM sleep and most prominently during sleep-wake transitions. There was also a more focal brief run of a regular 2 Hz rhythm in the central and frontal leads bilaterally. A referral was placed to Pediatric Neurology who ordered a full EEG which is pending at this time.
Conclusion: Sleep-related hallucinations may occur in narcolepsy, other sleep disorders, a mental disorder, a medical disorder, a medication effect or secondary to substance use. This case suggests that seizure activity may present as hypnopompic hallucinations as well.
Support (if any):

824

CASE SERIES ON THE USE OF VOLUME ASSURED PRESSURE SUPPORT IN PATIENTS WITH CHRONIC PULMONARY DISEASE AND PROGRESSIVE HYPERCAPNIA

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Introduction: Chronic hypercapnia results from destruction of lung parenchyma which occurs in chronic lung diseases including interstitial lung disease (ILD), bronchiectasis, and chronic lung transplant rejection. Many patients with these diseases will experience progressive respiratory failure eventually requiring consideration of transplantation or re-transplantation. Due to physiologic changes in sleep including reduction in tidal volume, worsening air tapping, and REM atonia, hypoventilation can be exacerbated during the sleeping hours. We present four patients who were prescribed nocturnal Volume Assured Pressure Support VAPS for their progressive hypercapnia.
Report of case(s): Subject 1 is a 72 year old female with severe bronchiectasis and restrictive lung disease due to TB pneumonia at a young age. Subject 2 is a 45 year old male with history of pulmonary cavitation due to extensive TB disease when he was younger. Subject 3 is a 45-year-old woman with rheumatoid arthritis related ILD with associated pulmonary arterial hypertension. Subject 4 is a 74 year old patient with a bilateral lung transplant for IPF complicated by bronchiolitis

obliterans syndrome who presented with progressive dyspnea and hypercapnia. Despite optimal therapy, all of these patients were admitted for hypercapnic and hypoxemic respiratory failure requiring treatment with BPAP then transitioned to nocturnal VAPS on discharge. For all patients, dyspnea and pCO2 improved as outpatients although all patients did eventually experience an exacerbation of their lung disease requiring repeat admission.
Conclusion: Due to the physiologic changes that occur with sleep, patients with severe lung disease may experience worsening CO2 retention while sleeping. There is little data assessing the use of chronic nocturnal non-invasive ventilation (NIV) to treat the hypercapnia of chronic lung diseases other than chronic obstructive pulmonary disease, extra-thoracic restriction, and neuromuscular disease. In this case series, nocturnal VAPS stabilized and/or reduced pCO2 in patients with pulmonary parenchymal disease of various etiologies. Additional studies are needed to assess long term effects of VAPS in these patients, including exacerbations, symptoms, and overall mortality.
Support (if any):

825

CENTRAL SLEEP APNEA AND SINUS BRADYCARDIA

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Introduction: Central sleep apnea (CSA) is characterized by a lack of respiratory drive during sleep resulting in repetitive periods of apneas. There are multiple manifestations of CSA as defined by the ICSD3. CSA with Cheyne-Stokes Breathing (CSB) is characterized by a series of crescendo-decrescendo pattern of ventilation followed by central apnea and is often associated with heart failure. Bradyarrythmias have been associated with obstructive sleep apnea (OSA), but an association with central sleep apnea is less clear.
Report of case(s): A 76 y/o male with no significant past medical history but with multiple instances of sinus bradycardia on previous EKGs, was referred to sleep medicine for evaluation of snoring, witnessed apneas, and daytime sleepiness. He had no history of CVA, CHF, atrial fibrillation, renal disease, or opioid use. PSG was completed for suspected OSA, and revealed moderate CSA (AHI 10.9 using hypopnea type 1B criteria, CAI 6.1). Central apneas at the latter portion of the study were consistent with a CSA-CSB. Awake heart rate at time of study was 44 bpm. During sleep, his heart rate ranged from 39–89 with a mean of 57 bpm. Due to this unexpected central apnea finding, cardiac evaluation was recommended and echocardiogram revealed a LVEF of 51%, a dilated left atrium, normal left ventricle chamber size, no wall motion abnormalities, and an inability to assess left sided filling pressures. EKG was consistent with sinus bradycardia without AV blocks. Holter monitor revealed sinus rhythm with moderate burden of ectopy. He underwent CPAP titration which revealed an effective CPAP pressure to control obstructive events, but central apneas persisted without CSB pattern.
Conclusion: In this patient, CSA/CSA-CSB was found in the absence of known risk factors for CSA. Although potentially an early sign of HFpEF related to his longstanding sinus bradycardia, this case raises the question as to whether sinus bradycardia in isolation could decrease cardiac output enough to destabilize ventilation and promote this finding of CSA/CSA-CSB.
Support (if any):

826

CENTRAL SLEEP APNEA ASSOCIATED WITH SODIUM OXYBATE– A CASE SERIES

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Introduction: Sodium oxybate (SO) is indicated to treat cataplexy and excessive daytime sleepiness (EDS) in patients with narcolepsy. Only a handful of cases have been reported of new-onset Central Sleep Apnea (CSA) in the setting of SO use. We present 3 patients who developed CSA in the setting of use of SO.
Report of case(s): Patient 1: A 25-y/o man presented with hypersomnolence. His diagnostic polysomnogram (PSG) showed moderate Obstructive Sleep Apnea (OSA), and he was placed on Continuous Positive Airway Pressure (CPAP) therapy. Due to persistent hypersomnia in the setting of effectively treated OSA, he had a Multiple Sleep Latency Test (MSLT), which revealed pathological sleepiness with a mean latency of 3.8 minutes with a sleep-onset REM on the overnight polysomnogram. SO was started for clinical diagnosis of Narcolepsy after he failed other stimulant medications. Hypersomnolence improved though data from his PAP device, home sleep studies, re-titration studies performed when he was on SO demonstrated CSA following 1st or 2nd dose of SO. Patient 2: A 17-y/o man was diagnosed to have Narcolepsy with Cataplexy, based on PSG followed by MSLT. 20 years later, he was diagnosed with OSA based on a PSG and was treated with CPAP. A few years later, he was started on SO for fragmented sleep and EDS. A home sleep study performed when he was on SO, revealed CSA. Later, an in-lab titration study showed CSA with Cheyne-Stokes respiration (CSR), treated with Adaptive Servo-Ventilation (ASV) therapy. Patient 3: A 15-y/o man initially presented after several cataplectic episodes and was diagnosed with Narcolepsy with Cataplexy. His initial PSG showed no evidence of sleep-disordered breathing. A few years later, for persistent cataplectic events, he was started on SO with improvement in the episodes' frequency. Several years later, a baseline PSG demonstrated OSA and CSA, with frequent CSA events soon after taking SO. The CPAP titration study, performed following the PSG, also revealed frequent CSA following the second dose of SO.
Conclusion: Close monitoring is warranted with SO use, given some narcolepsy patients' predisposition to develop CSA. Follow-up studies are needed to address the pathogenesis and management strategies.
Support (if any): None

827

CENTRAL SLEEP APNEA IN A PATIENT WITH MULTIPLE SCLEROSIS

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Introduction: Sleep-disordered breathing is common in persons with multiple sclerosis (PwMS), and may contribute to debilitating fatigue and other chronic MS symptoms. The majority of research to date on SDB in MS has focused on the prevalence and consequences of obstructive sleep apnea; however, PwMS may also be at increased risk for central sleep apnea (CSA), and the utility of methods to assess CSA in PwMS warrant further exploration. We present a patient with secondary progressive multiple sclerosis who was found to have severe central sleep apnea on WatchPAT testing.
Report of case(s): A 61 year-old female with a past medical history of secondary progressive multiple sclerosis presented with complaints of fragmented sleep. MRI of the brain, cervical spine, and thoracic spine showed numerous demyelinating lesions in the brain, brainstem, cervical, and thoracic spinal cord. Upon presentation, the patient noted snoring, witnessed apneas, and daytime sleepiness. WatchPAT demonstrated severe sleep apnea, with a pAHI of 63.3, and a minimum oxygen saturation of 90%. The majority of the scored events were

non-obstructive in nature (73.1% of all scored events), and occurred intermittently in a periodic fashion.
Conclusion: The differential diagnosis of fatigue in PwMS should include sleep-disordered breathing, including both obstructive and central forms of sleep apnea. Demyelinating lesions in the brainstem (which may contribute to impairment of motor and sensory networks that control airway patency and respiratory drive), and progressive forms of MS, have been linked to both OSA and CSA. The present data illustrate this relationship in a person with progressive MS, and offer support for the WatchPAT as a cost-effective means to evaluate for both OSA and CSA in PwMS, while reducing patient burden. PwMS may be at increased risk for CSA. Careful clinical consideration should be given to ordering appropriate sleep testing to differentiate central from obstructive sleep apnea in PwMS, particularly for patients with demyelinating lesions in the brainstem.
Support (if any): 1. Braley TJ, Segal BM, Chervin RD. Obstructive sleep apnea and fatigue in patients with multiple sclerosis. J Clin Sleep Med. 2014 Feb 15;10(2):155–62. doi: 10.5664/jcsm.3442. PMID: 24532998; PMCID: PMC3899317.

828

CHALLENGES OF ARTIFACT IN POLYSOMNOGRAPHY-AN LVAD STORY.

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Introduction: Congestive heart failure and sleep-disordered breathing frequently coexist. Many of these patients are referred for polysomnography(PSG). Left ventricular assist device (LVAD) is increasingly used as a destination therapy or as a bridge to transplant. This can lead to artifacts in EEG and EKG. The artifact can mask pathological waves or over-reading of pathology. We present a case report of a patient who underwent a PSG on LVAD.
Report of case(s): Sixty-six-year old male with severe heart failure with reduced ejection fraction (EF) of 15 % presented with snoring and witnessed apnea. The patient was diagnosed with predominant central sleep apnea (92%) but never initiated BPAP/ST due to an unstable heart. He was placed on LVAD (HeartMate III LVAD, oscillatory speed of 5300 rpm/83.3Hz) as the heart status deteriorated. Repeat polysomnography was done for persistent snoring but improved witnessed apneas revealed a newly appearing artifact. EEG showed a diffuse low amplitude,6–7 Hz frequency waves, and a regularly appearing high voltage sharp-peaked wave. The morphology of alpha wave, K wave, spindles, and delta waves could not be appreciated and hence was unable to perform sleep staging. EKG had electrical artifacts. All troubleshooting maneuvers were unsuccessful in eliminating artifacts. The artifact is generated by the impeller rotational speed of LVAD that ranges from 2400 rpm to 10,00 rpm(oscillation frequencies of 40 Hz to 166.7 Hertz,1Hz == 60 rpm). The device's artificial pulse causes additional minor peaks. EEG artifact can be improved by moving the amplifier away from the heart and repositioning the patient. Adjusting the low-frequency filter can affect the nasal pressure tracing, delta waves, and stage 3 recognition. Reducing the high-frequency filter frequency by 10 from the LVAD oscillation frequency improves the EKG signal. But this may cut off the frequency component of pathologies like left ventricular hypertrophy.
Conclusion: The LVAD has been increasingly used in the United States. It is important to improve awareness regarding the artifacts among sleep techs and physicians. Unresolved artifacts may lead to missing serious pathologies in EEG and EKG and also can lead to misreading the waves as pathological leading to unnecessary treatment.
Support (if any): An image of EEG and EKG

829

CHRONIC SLEEP DEPRIVATION IN A 75-YEAR-OLD FEMALE LEADING TO MICRO-SLEEPS WITH ATONIA CAUSING INCREASED FALLS

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Introduction: Each year, 3 million older people are treated in emergency departments for fall-related injuries. These falls can lead to serious injuries and expensive health care costs. Some have looked into the relationship between chronic sleep disturbances and falls linking chronic sleep deprivation or excessive sleep to falling. Here, we present a unique case of chronic sleep deprivation causing sleep attacks or micro-sleeps with atonia causing falls.
Report of case(s): We present a 75-year-old F with a history of increased daily falls up to 4x per day that began 3 years ago. She denies any triggering events, auras, frequent tripping, loss of balance or weakness. Reportedly, she will be walking along then suddenly falls. She is aware that she is falling yet feels as though she cannot prevent/stop the fall or break her fall. No one has witnessed her fall, but is frequently found lying on the floor. She has never sustained a serious injury as a result of her falls. She has an 8 year history of restless legs syndrome treated with ropinirole and a 10 year history of obstructive sleep apnea (OSA) treated with CPAP. Her general bedtime is 2200 and wake-time is 0400 with an average 3–4 hrs of quality sleep per night for many years. She endorses severe daytime hypersomnolence and chronic hypoxemia on 3L home oxygen. We hypothesized her falls were secondary to sleep attacks or micro-sleeps where she enters REM sleep and develops atonia. Nocturnal sleep study followed by MSLT showed severe OSA with severe, persistent daytime sleeping with REM sleep and atonia. She had a mean sleep latency of 2 minutes with 1 sleep-onset REM period. We started NIPPV with supplemental oxygen treatment, and within 4 months her daytime hypersomnolence resolved, exercise intolerance improved, saturations improved to 89–90% on room air, and has <1 fall per day.
Conclusion: Here, we presented a unique case of a 75 yo F with recurrent falls secondary to chronic sleep deprivation causing micro-sleeps involving REM sleep and atonia. She was treated with NIPPV which improved her oxygenation and reduced her number of falls to <1 per day.
Support (if any):

830

COMBINED PHOTOTHERAPY AND MELATONIN FOR TREATMENT OF CIRCADIAN RHYTHM DISORDER IN A PATIENT WITH CORNELIA DE LANGE SYNDROME

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Introduction: Cornelia de Lange syndrome (CdLS) is a rare genetic disorder characterized by variable physical, cognitive, and behavioral characteristics. Sleep disturbances have been frequently reported in CdLS including insomnia, sleep-disordered breathing, intrinsic sleep disorders, and circadian rhythm disorders (CRDs). The characterization and prevalence of CRDs in CdLS remain ill- defined. We report a case of a 13-year-old female with CdLS presenting with advanced sleep wake phase disorder (ASWPD).

Report of case(s): A 13-year-old female with a past medical history of CdLS, developmental delay, bilateral cleft palate status post repair presents with inability to fall asleep at night and excessive daytime sleepiness.(EDS) Her sleep history consists of going to bed at 4 pm with no delayed sleep onset. She wakes at 2:30 am which has occurred since infancy. Mother reports the patient will remain awake from 2:30 am until she goes to school at 7:30 am. History is consistent with EDS and sleeping during the day while at school. Total sleep time of approximately 11–12 hours was reported in 24-hour period. History of obstructive sleep apnea, parasomnias, insomnia, restless leg syndrome, and psychotropic medications were not reported. Patient was treated with timed low dose melatonin therapy 0.5 mg at 4 pm and bright light therapy using 10,000 lux for 30 minutes at 7 am and 4 pm. Dim lights starting at 7:30 pm with structured scheduled sleep hygiene ensuring consistent bedtime at 9:30 pm. A consistent wake time at 7 am and no naps during the day was recommended. Follow up visits report successful response to therapy with attainment of desired sleep wake rhythm (bedtime at 9:30 pm and wake time at 7 am) and resolution of sleepiness during the day. Our patient was able to be weaned off of melatonin and light therapy and her circadian rhythm remained entrained.

Conclusion: Patients with disorder such as CdLS are at risk for circadian rhythm disorders. Our patient responded well to treatment with combined timed phototherapy and low dose melatonin therapy. Better knowledge and characterization of typology of CRDs in CdLS patients could permit a more specific therapeutic approach to sleep disorders in this population.

Support (if any): None

831

DIAGNOSTIC AND TREATMENT CHALLENGES IN A CHILD WITH TYPE 1 NARCOLEPSY

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Introduction: The diagnosis and management of Narcolepsy can be challenging in young children. We present a case of abrupt onset severe type 1 narcolepsy complicated by tactile hallucinations with stimulant medication therapy.

Report of case(s): A previously healthy 7-year-old African American female presented to us at the beginning of the current pandemic with one week of excessive daytime sleepiness (EDS) with associated enuresis, hyperphagia and two episodes of cataplexy. She also presented with hypnagogic hallucinations and dream enactment behaviors. She was extremely sleepy with a score of 24/24 on the Epworth Sleepiness Scale. Her neurological exam was negative except for facial twitching appearing to be cataplectic facies. Extensive work up including urine toxicology, serology and cerebrospinal fluid (CSF) tests were undertaken to rule out infectious and demyelinating conditions; the results of these tests were negative. Brain magnetic resonance imaging as well as electroencephalogram testing were unremarkable. Overnight polysomnography demonstrated short sleep latency and rapid eye movement (REM) sleep without atonia and a multiple sleep latency test showed a mean sleep latency of less than 2 minutes and 4/4 sleep onset REM periods, highly suggestive of narcolepsy. Her HLA DQB1*0602 haplotype was positive but CSF Hypocretin testing was not done. She was given a diagnosis of Narcolepsy type I and started treatment on low dose Methylphenidate and Venlafaxine to address her EDS and cataplexy, respectively. Her EDS was gradually controlled with a higher dose of Methylphenidate but she developed severe tactile hallucinations. She complained of feeling bugs crawling under her skin and could not keep her clothes on due to constant discomfort. The tactile hallucinations improved with discontinuation of methylphenidate but reappeared with introduction of a different class of stimulants. Modafinil was ineffective in controlling her EDS symptoms. Her EDS, cataplexy and enuresis were better controlled after starting her on Sodium Oxybate. She continues to suffer from moderate to severe EDS with optimally dosed Sodium Oxybate with suboptimal response to various typical and atypical stimulants.

Conclusion: This case illustrates the difficulties in diagnosing and treating pediatric narcolepsy patients and a unique challenge of tactile hallucinations with stimulant medications.

Support (if any):

832

DOSE-DEPENDENT QUETIAPINE-INDUCED SOMNAMBULISM AND SLEEP-RELATED EATING DISORDER

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Introduction: Parasomnias are abnormal sleep-related movements that can occur during non-rapid eye movement sleep, rapid eye movement sleep, or transition of sleep. The prevalence of parasomnias in young children ranges from 9–40% which may be underestimated as this relies on parental recall. There are multiple reported cases of pharmacologically-induced parasomnias. Quetiapine is an atypical antipsychotic medication associated with somnambulism and sleep-related eating disorder.

Report of case(s): A 9-year-old female with a history of attention deficit hyperactivity disorder, post-traumatic-stress disorder, depression, and sexual abuse during childhood presented to the Sleep Medicine Clinic for two years of worsened sleepwalking and sleep eating. Her medications included Methylphenidate, Quetiapine, Clonidine, and Duloxetine. She has had parasomnias since she was 3-years-old, initially presenting as abnormal sleeping positions (standing or sitting). She was initiated on Seroquel at 4-years-old, but parasomnias worsened over the last two years when Quetiapine was increased from 50 mg to 200 mg for behavioral and mood issues. Her somnambulism began to occur nightly. The family was required to remove all items from her bedroom except for the bed to prevent major injuries. She also had significant changes to her eating habit: she would eat two to three times her normal quantity as well as eating while asleep. The family would find her eating ice cream, chips, grapes, cold tortillas, or anything she was able to access. Fortunately, she did not consume raw meat or other frozen foods. The child did not have any recollection of eating at night. Psychiatry worked with her to cross-taper Quetiapine and Topiramate. At the lower dose of Quetiapine, she had exacerbation of her mood symptoms, paranoia, and insomnia; therefore, Topiramate was discontinued and Quetiapine was titrated to 150 mg with improvement in mood symptoms, insomnia, and resolution of sleep-related eating disorder. She continues to have somnambulism.

Conclusion: This case illustrates that quetiapine-induced somnambulism and sleep-related eating disorder can be dose-dependent; thus, important for clinicians to educate patients and/or family members of adverse effects while titrating quetiapine.

Support (if any):

833

EVOLUTION OF SLEEP DISORDERED BREATHING TYPES IN HEART FAILURE

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Introduction: Central sleep apnea is commonly seen in patients with heart failure. Here we present a case demonstrating shifting of predominant apneic events from central to obstructive type after placement of left ventricular assist device (LVAD) in end stage heart failure patient.
Report of case(s): Case Presentation: 66 year-old African American male has past medical history of chronic congestive heart failure diabetes, hypertension, paroxysmal atrial fibrillation, anemia, hypothyroidism, chronic kidney disease and sleep apnea. Prior to his LVAD placement, his left ventricular ejection fraction (EF) was <10%. Patient was diagnosed with central sleep apnea with AHI of 58 (with 92% of apneic events being central events), oxygen nadir of 74%. Subsequently, patient had LVAD placed for symptomatic heart failure and repeat polysomnogram repeated at six month demonstrated an improved AHI of 45.8 with predominantly obstructive and mixed apneic events, with only 12.5% being central events.
Conclusion: This case report highlights not only the improvement of the sleep apnea in CHF treated with LVAD but also shows the shift of apneic events from predominantly central to obstructive type post LVAD.
Support (if any): 1. Henein MY, Westaby S, Poole-Wilson PA, Cowie MR, Simonds AK. Resolution of central sleep apnoea following implantation of a left ventricular assist device. Int J Cardiol. 2010 Feb 4;138(3):317–9. PMID: 18752859. 2. Köhnlein T, Welte T, Tan LB, Elliott MW. Central sleep apnoea syndrome in patients with chronic heart disease: a critical review of the current literature. Thorax. 2002 Jun;57(6):547–54. PMID: 12037232 3. Monda C, Scala O, Paolillo S, Savarese G, Cecere M, D'Amore C, Parente A, Musella F, Mosca S, Filardi PP. Apnee notturne e scompenso cardiaco: fisiopatologia, diagnosi e terapia [Sleep apnea and heart failure: pathophysiology, diagnosis and therapy]. G Ital Cardiol (Rome). 2010 Nov;11(11):815–22. Italian. PMID: 21348318.

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HELP ME STOP EATING PLEASE. . .

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Introduction: Sleep related eating disorder (SRED) is an uncommon NREM parasomnia, predominantly seen in females in their 20s and 30s and is commonly associated with sleep walking, daytime eating disorders (anorexia and bulimia) and use of certain sedative-hypnotics. Here, we describe a case of unique therapeutic dilemma in a middle-aged female, in whom SRED affected the use of continuous positive airway pressure device (CPAP) for her obstructive sleep apnea (OSA) which lead to worsening sleep quality and daytime functionality.
Report of case(s): 42-year-old female with history of migraines and OSA, came to the clinic with 6-month history of SRED which started after the demise of her husband and was associated with significant weight gain and injuries. During typical episode, she would take CPAP mask off, walk down the stairs and eat in the kitchen area and then fall asleep in the living area. She denied predilection for particular food, food allergies, consumption of inedible materials or use of offending drugs. Upon further inquiry, she reported recent unsuccessful attempts at smoking cessation, frequent nighttime smoking, significant body image issues and discontinuation of topiramate use for her migraines recently. Telemedicine visit limited the physical examination but included increase in BMI from 32 to 35 kg/m2. Compliance report, sleep diary and surveillance videos were consistent with the history with compliance report showing 17% of nights with optimal usage and 59% of nights with any usage. Beside locking the food, safety measures and napping, we recommended her to use clonazepam 1.5 mg. Unfortunately, she continued to have episodes. She was then started on Topiramate 50 mg which was gradually increased to 100 mg with reduction in her episodes and increase in her compliance to 60%.
Conclusion: In sleep medicine, treatment of OSA usually precede the treatment of comorbid conditions. However, SRED with comorbid OSA, requires a reverse strategy where improvement in compliance and coexisting daytime symptoms requires the treatment of SRED first. Moreover, detailed history to investigate the potential precipitating factors, co-existing medical and sleep conditions can help with choice of therapy e.g. patients with depression and SRED can benefit from Selective Serotonin Reuptake Inhibitors rather than other choices.
Support (if any):

835

ICTAL CENTRAL APNEIC EVENTS DETECTED ON POLYSOMNOGRAM: AN EDUCATIONAL CASE REPORT

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Introduction: Ictal central apneas (ICA) are frequently observed in focal epilepsy, mostly with temporal lobe seizures, and have been considered as potential biomarkers of sudden unexpected death in epilepsy (SUDEP), particularly when they are prolonged and associated with significant hypoxemia. We present an interesting educational case report of occurrence of such ictal apneic events as recorded during a nocturnal diagnostic polysomnogram (PSG).
Report of case(s): A 39-year-old woman with history of left focal epilepsy, hypertension, and headaches was referred to the sleep clinic for loud snoring, witnessed apneic events, and excessive daytime sleepiness. She subsequently underwent a diagnostic (PSG) that demonstrated severe obstructive sleep apnea (apnea-hypopnea index of 63.1) associated with significant hypoxemia (nadir SpO2 of 58%). In addition, the patient had one ictal discharge detected on the PSG's limited electroencephalogram that occurred in N2 sleep and lasted for almost three minutes with a focal onset and progression in the left hemisphere. The ictal discharge was briefly preceded by central apneic events that continued to occur during and shortly after the termination of the ictal discharge. These ICA events were associated with severe oxygen desaturations down to an SpO2 of 62%. The only time during the PSG recording that the patient had central apneic events was around the ictal event. There were no behavior changes on the video during the seizure, but the ictal discharge was associated with a sustained increase in the mentalis muscles activity and a brief tachycardia. The patient's neurologist was alerted about the above findings on PSG. The patient was taking a lower dose then prescribed of her anti-epileptic medication (topiramate) that was adjusted, and the patient was counseled on the risks associated with the above findings and positive airway pressure therapy was recommended for her severe sleep apnea.
Conclusion: The above case report illustrates the importance of polysomnography (specifically the recording of respiratory variables rarely performed in epilepsy monitoring units) in the evaluation of patients with epilepsy given that central apneic events (ICA and post-convulsive central apneas) potentially underlie SUDEP, the most common cause of mortality in refractory epilepsy patients and usually occurring during sleep.
Support (if any): None

836

ISSUES WITH SLEEP CAN BE SKIN DEEP: MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA IN CUTANEOUS SARCOIDOSIS

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Introduction: Introduction/Background: PAP Intolerance is a common initial complaint among new PAP users, with mask issues and difficulty with pressure level leading the list. In clinical practice, feelings of claustrophobia and anxiety are usually cited as the reason for PAP intolerance. Sometimes craniofacial impairments such as congenital malformations or change in facial architecture after a major accident or surgery may play a role. Our case describes our experience with a patient afflicted with severe sinonasal cutaneous Sarcoidosis.
Report of case(s): Case Description: A 43 year old AAF with a PMH of morbid obesity, depression and cutaneous sinonasal Sarcoidosis was referred to Sleep Medicine by ENT in late May 2020 with complaints of snoring, witnessed apneas, excessive daytime sleepiness, fatigue, and non-restorative sleep for >20 years. The patient was first diagnosed with cutaneous Sarcoidosis limited to the internal sinonasal region around 2015 and managed by ENT until the lesions spread to her face. Due to this, the patient developed depression and became increasingly non-complaint with her medical regimens. As a result, her sarcoidosis and other co-morbidities worsened. Diagnostic Polysomnogram (PSG) in May 2020 showed presence of Hypopnea predominant Obstructive Sleep Apnea (OSA) with AHI 35.9 and O2 desaturation to 58%. Subsequently, the patient was placed on auto CPAP 6–20 cm H2O with a DreamWear FFM. At follow up in September 2020, her sarcoidosis had spread to her upper lip area, so she was prescribed a Fit Life mask to avoid this region. Follow up in December 2020 revealed improvement in Sarcoidosis and accompanying vast improvement in objective compliance though she reverted to using her DreamWear FFM due to "mask seal issues. An AirFit f20 mask was then given to help avoid the active lesions on her upper lip.
Conclusion: Discussion/**Conclusion:** In patients with compromised facial architecture, special attention must be paid to the type of mask interface used so it does not aggravate sensitive areas which may lead to poor compliance with PAP therapy. Instructions were given for her to alternate between her three masks—the Fit Life, the DreamWear FFM and the AirFit f20 FFM—in an effort to reduce irritation on her face over time.
Support (if any):

837
NARCOLEPSY IN A TODDLER
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Introduction: Narcolepsy is a central disorder of hypersomnia with a bimodal peak incidence at ages 15 and 35. Onset in early childhood has been reported, but rarely under the age of 5. We present a case of Narcolepsy Type 1 in a 2.5-year-old with dropping spells.
Report of case(s): A 2.5-year-old African American healthy male presented with acute onset sudden drops, unsteady gait, and staring spells. These episodes lasted a few seconds, occurred multiple times a day, and were associated with eye fluttering and dysarthric speech. History was notable for increased daytime sleep/sleep attacks, disrupted nocturnal sleep with confusional arousals, nightmares and sleepwalking, weight gain and mood instability with aggressive behavior. No preceding head injury or illness. Physical examination demonstrated frequent atonic episodes with loss of deep tendon reflexes. A clinical suspicion of myoclonic/atonic epilepsy prompted video- electroencephalogram (EEG) which showed frequent bursts of generalized intermittent slowing representative of NREM 1 sleep lasting several seconds. Magnetic resonance imaging of the brain and infectious workup was unremarkable. Cerebrospinal fluid (CSF) Orexin was <50 pg/mL. While 76–98% of patients with narcolepsy type-1 have HLADQB1*06:02, our patient tested negative. Due to lack of MSLT validity at this age, only diagnostic PSG was performed which showed REM without atonia and sleep fragmentation. Prior to sleep onset, cataplexy was observed in the patient while laughing, though EMG tone was relatively preserved during this episode. We had limited treatment options considering lack of FDA approved medications for ages less than 7. A helmet was prescribed to prevent head injury. Methylphenidate 5mg/day improved sleepiness and slightly stabilized mood. For cataplexy, neither Fluoxetine nor Imipramine helped. His mother disapproved further medication trials. Continuing methylphenidate, the family was referred to behavior psychology for support, coping with the diagnosis and behavioral changes.
Conclusion: This case demonstrates an unusual presentation of Narcolepsy Type 1 in a toddler initially thought to have epilepsy. Video-EEG and low CSF orexin led to the diagnosis. His age, severity of cataplexy, mood changes, and parental concerns made treatment challenging. Furthermore, this case highlights the importance of early recognition of Narcolepsy in young children to provide appropriate treatment during critical developmental stages.
Support (if any):

838
NOT ALL HYPERCAPNIA IS COPD
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Introduction: Sleep breathing disorder related to isolated unilateral or bilateral diaphragmatic dysfunction (DD), in the absence of a generalized neuromuscular disorder, is not well understood and often under-recognized. There have been only a few cases reported of apneas and hypoponeas during REM sleep due to diaphragmatic dysfunction. We present here, a case of an 62 year-old man who developed acute hypercapnic respiratory failure with presumed COPD exacerbation requiring invasive ventilation.
Report of case(s): A 62-year-old man was found on the sidewalk extremely short of breath and was intubated in the emergency department. Initial post-intubation arterial blood gas showed pH 7.1, pCO2 82, pO2 263, CO3 25.5. CXR showed no infiltrates. Echocardiography showed EFof 55%-65%. Long-term tobacco use supported the picture of COPD exacerbation. However, PFT was within normal limits. HSAT one year prior which showed severe OSA with AHI 52.6 event per hour. Patient had not pursued positive airway pressure (PAP) titration study afterward. In ICU, he was treated for presumed COPD exacerbation and successfully weaned off invasive ventilation. Inpatient PAP titration study recommended IPAP 12 and EPAP 8 cm H20. A fluoroscopy of the diaphragm was performed and showed that the right diaphragm had limited mobility. Electromyogram did not show generalized myopathy.
Conclusion: In conclusion, this case report describes the presentation of sleep disordered breathing seen in patients with unilateral diaphragmatic palsy. In these patients, the respiratory events seen are mainly hypopneas and desaturations, worse in REM sleep and supine position. This was an unusual presentation of a patient with untreated OSA and unilateral diaphragmatic palsy. A characteristic finding in these patients is worsening of the OSA in supine position. This has been reported in several studies and was seen in our case as well. This case underscores the need for critical thinking and diagnostic reasoning in the evaluation of a patient with hypercapnic respiratory failure and consider a wide differential and not only COPD exacerbation as the cause. Unilaterally diaphragmatic palsy is a rare cause of hypercapnic respiratory failure but must be considered when seen with obstructive sleep apnea with predominantly hypopneas and hypoxemia out of proportion of the respiratory events.
Support (if any):

839

NOT YOUR EVERYDAY DAYTIME SLEEPINESS: TWO PEAS IN A POD

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Introduction: Obstructive sleep apnea (OSA) and narcolepsy are both causes of excessive daytime sleepiness (EDS). OSA is a more prevalent diagnosis, but it can coexist with narcolepsy and confound diagnosis. We present a case of a delayed diagnosis of type 2 narcolepsy in a patient with known OSA.
Report of case(s): A 31-year-old man with depression treated with sertraline and prior history of severe OSA diagnosed at an outside facility presented to our clinic for residual excessive daytime sleepiness. He demonstrated adequate adherence to continuous positive airway pressure (CPAP) of 13 cmH2O over a period of one year, good sleep hygiene and adequate sleep duration. He reported vivid dreams and sleep paralysis in the past, but none recently. There was no history of a delayed sleep phase. He denied hypnagogic or hypnopompic hallucinations or cataplexy. An in-lab polysomnogram (PSG) followed by multiple sleep latency test (MSLT) was ordered for further evaluation. Sertraline was held 2 weeks prior to the study. Overnight PSG on CPAP showed adequate treatment of OSA on CPAP pressures of 13–16 cmH2O. MSLT showed 3/5 sleep-onset rapid eye movement periods with a mean sleep latency of 5.8 minutes. A diagnosis of coexisting type 2 narcolepsy was made. Treatment was initiated with modafinil; however, his symptoms of EDS persisted and he was changed to methylphenidate with subsequent improvement.
Conclusion: The case above highlights the importance of maintaining a broad differential when investigating the etiology of EDS. In particular, patients with narcolepsy often experience a significant delay between onset of symptoms and receiving a diagnosis. Diagnosis can be confounded by a lack of classic symptoms and/or the presence of another sleep-related breathing disorder, as in the patient above. Residual EDS can be seen in patients with adequately treated OSA. There is sparse data regarding the co-prevalence of narcolepsy as the etiology of residual EDS in adequately treated OSA. Patients should still be screened for symptoms suggestive of narcolepsy. Persistence of EDS symptoms in young adults with adequately treated OSA should raise suspicion for another sleep-related disorder and merits further investigation.
Support (if any):

840

OBSTRUCTIVE TO CENTRAL: A SWITCH IN SLEEP APNEA TYPE AFTER ARTERIOVENOUS MALFORMATION RUPTURE

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Introduction: Sleep apnea and stroke have long been shown to be linked, with sleep apnea increasing the risk for stroke and stroke leading to sleep apnea. When the latter occurs, it can present as central sleep apnea (CSA), often in the form of Cheyne-Stokes breathing (CSB), and has been shown to resolve over time. We present a patient with persistent CSA after severe hemorrhagic stroke secondary to rupture of a temporal/thalamic arteriovenous malformation (AVM).
Report of case(s): A 33-year-old man with a history of obstructive sleep apnea (OSA) presented to our clinic for re-evaluation of his disease. He was diagnosed with OSA in 2006 at which time he was 270 pounds with a body mass index (BMI) of 36.7, thus the OSA was thought to be secondary to obesity. When he presented to our clinic 10 years later, he had lost approximately 80 pounds after suffering multiple strokes. In 2014, he had a left temporal lobe hemorrhage due to rupture of a left temporal/thalamic AVM and required decompressive hemicraniectomy. In 2015, he had a re-bleed of this AVM, with new hemorrhage extending inferiorly into the left cerebral peduncle and pons, and superiorly into the left parietal periventricular white matter anteriorly along the optic tract. Ultimately, he was treated with stereotactic radiotherapy to the AVM nidus with no residual AVM. However, he has chronic encephalomalacia of the left basal ganglia, thalamus, temporal, parietal, and occipital lobes with extension into the left cerebral peduncle and changes consistent with radiation necrosis. His residual symptoms are aphasia and right-sided hemiplegia and although his snoring resolved with weight loss, his mother noticed pauses in his breathing overnight. A repeat sleep study done in 2016 showed 27 central apneas and 0 obstructive apneas with an AHI of 5.4 events/hour. He was subsequently studied on ASV with residual AHI of 0.4 events/hour.
Conclusion: Although patients with OSA may be at higher risk for stroke, it is important to re-evaluate their sleep apnea after such an event to ensure appropriate diagnosis and treatment going forward.
Support (if any):

841

PAP THERAPY DATA PROVIDES CLUES TO COMORBID SLEEP DISORDERS

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Introduction: Obstructive sleep apnea (OSA) is a common condition and positive airway pressure (PAP) therapy is the treatment of choice. Treatment guidelines recommend monitoring objective PAP usage data to track treatment efficacy. A typical report includes the percentage of days/month and cumulative hours/day a PAP device was used. In addition, PAP therapy timing can be graphically viewed with use plotted by time/day. This latter presentation reveals patterns of usage that can identify comorbid sleep disorders.
Report of case(s): Case 1: A 65-year-old male with OSA presented with sleep inertia despite compliance with PAP therapy. Therapy timing data revealed a delayed circadian phase, with bedtime of 4 am and wake time of 1 pm. Circadian phase advancement therapy was added. Case 2: An 86-year-old male with OSA presented with daytime sleepiness after years of excellent PAP usage. Two years earlier, he was diagnosed with Parkinson's disease and developed increasing afternoon sleepiness. Compliance data showed a mild reduction in PAP usage. However, therapy timing data revealed an irregular sleep-wake rhythm disorder with sleep scattered around the clock, consistent with neurodegenerative disease. Case 3: A 70 year-old-female with PTSD and OSA presented with persistent tiredness and difficulty initiating and maintaining sleep despite good compliance with PAP therapy. Her timing data showed irregular sleep times with long gaps in usage suggestive of sleep maintenance insomnia. After starting a behavioral treatment regimen her pattern regularized and awakenings reduced, seen by consistent PAP use. Case 4: An 80-year-old female with OSA complained of early morning awakenings despite PAP use with good compliance. Review of PAP therapy timing revealed a pattern suggestive of advanced sleep-wake phase disorder. Circadian phase delay therapy was started.
Conclusion: Patients with OSA on PAP therapy may have comorbid sleep disorders impacting sleep quality. PAP therapy data can provide information on sleep-wake behavior similar to actigraphy to help diagnose these conditions and track treatment response.

Support (if any): None

842

PAP THERAPY IN A PANDEMIC: MANAGEMENT OF SEVERE MIXED APNEA PREDOMINANT OSA & CSA DURING THE COVID-19 PANDEMIC

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Introduction: Introduction/Background: A new protocol and standard of care was created amidst the COVID-19 Pandemic that began in 2020. Traditional split night studies fell out of favor and were replaced by solely diagnostic studies with placement on Auto-PAP therapy if treatment of sleep disordered breathing was required. Some patients, however, required a more tailored approach if diagnostic polysomnogram (PSG) was particularly concerning. Our case report describes the treatment of a patient with severe Mixed Apnea Predominant Obstructive Sleep Apnea (OSA) with accompanying Central Sleep Apnea (CSA) using COVID-19 Precautions.
Report of case(s): Case Description: A 48 year old AAM patient with a PMH of HTN, pre-diabetes, GERD, obesity and tobacco abuse initially presented to Sleep Medicine in late January 2020 with complaints of snoring, witnessed apneas, waking up gasping, excessive daytime sleepiness, fatigue, and non-restorative sleep for many years with ESS 24 and FSS 48 on initial evaluation. Diagnostic PSG showed AHI 76.9 with O2 desaturation to 59% and demonstrated the presence of severe Mixed Apnea predominant OSA and CSA with worsening during REM sleep. Because of the severity, he underwent a PAP titration in August 2020 using the AASM COVID-19 sleep study precautions which included use of a negative pressure room. Optimal control of snoring, apneic respiratory events and oxygen desaturations was achieved at 14 cm H2O in the supine body position during REM sleep. Follow up with Sleep Medicine in October and December 2020 showed objective compliance over a 30 day period not completely at goal due to issues with mask desensitization and sleep hygiene, however the patient subjectively reported that he noticed great improvement in snoring, excessive daytime sleepiness and fatigue.
Conclusion: Discussion/**Conclusion:** With a diagnosis of Severe Mixed Apnea Predominant OSA as well as CSA noted during the study, the differential diagnosis included CHF, Chiari malformation, opioid abuse and idiopathic CSA as the cause. Despite a dangerous pandemic, appropriate therapy for certain patients must still be attained. Special protocols developed during the COVID-19 Pandemic allowed for our patient to receive adequate treatment, while ensuring the safety of all involved.
Support (if any): References COVID 19: FAQs for Sleep Clinicians. AASM official website. https://aasm.org/covid-19-resources/covid-19-faq/

843

PARADOXICAL WAKING HYPOXEMIA THAT IMPROVES WITH SLEEP

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Introduction: We present a case of paradoxically worsened hypoxia during wake phase of polysomnography while undergoing a CPAP titration study. Nighttime hypoxemia is a common feature in obstructive sleep apnea, due to obstructive events that manifest while sleeping. Excluding OSA, there remains an extensive differential for disease processes that cause hypoxemia while asleep; however, none of these processes can explain waking hypoxemia that improves upon sleeping.
Report of case(s): A 70 year old male with severe OSA diagnosed by home sleep test (REI 46.5, nadir O2=76%) underwent polysomnography with PAP titration and demonstrated several hours of interrupted sleep without hypoxia and minimal obstructive events on CPAP 9–13 cmH2O. During the study, while awake at CPAP of 14 cmH2O, he developed hypoxia to mid-high 80s and supplemental oxygen bleed in was added starting at 3L and increased to 5L during a prolonged period of wakefulness. On CPAP 15 cmmH2O with 5L bleed-in, the patient fell asleep and oxygen saturation again increased to low 90s. He underwent an extensive workup for other cardiopulmonary causes of hypoxemia, with pulmonary function testing showing moderate obstructive ventilatory defect and mild DLCO impairment. An echocardiogram with saline contrast bubble study was relatively unremarkable, without evidence of right to left shunting. He underwent a chest CTA which was negative for pulmonary embolism, though it did reveal an enlarged pulmonary artery consistent with pulmonary hypertension. His chronic hypoxemia was treated with 2L supplemental oxygen during the day and bleed-in with CPAP at night.
Conclusion: Though nocturnal hypoxemia is common with OSA, polysomnography with paradoxical hypoxemia during wake phase has not been reported. Notably, the patient was without prolonged hypoxia during his sleep phase while on CPAP treatment with minimal apneic/hypopneic events. Pulmonary hypertension can also present as nocturnal hypoxemia, but it should worsen with sleep, rather than improve. There are case reports of right to left shunting worsened by PAP, though his hypoxemia persisted despite PAP. His paradoxical worsening hypoxemia with wakefulness is still unexplained.
Support (if any):

844

PEDIATRIC VAGUS NERVE STIMULATOR-INDUCED OBSTRUCTIVE SLEEP APNEA

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Introduction: Vagus nerve stimulation (VNS) is an adjunct treatment for seizures refractory to medications. VNS in children with epilepsy can reduce seizures by up to 90%. VNS settings include stimulation on-time, off-time, frequency and output current. Complications of VNS include sleep-disordered breathing due to laryngopharyngeal dysfunction, which can also cause voice alteration, hoarseness, and cough. Both obstructive apneas (more common) and central apneas can be seen in those patients who have VNS-induced sleep-disordered breathing.
Report of case(s): A 14-year-old male with Lennox-Gastaut syndrome treated with multiple antiepileptic drugs and VNS was admitted to the PICU with worsening seizures. He developed acute respiratory failure due to status epilepticus, requiring intubation. After extubation, he was observed to have repetitive respiratory obstruction at regular intervals, occurring throughout the day and night, and associated with mild oxygen desaturations. Polysomnography showed cyclical obstructive respiratory events lasting 30 seconds followed by approximately 2-minute intervals of regular breathing. Interrogation of his VNS device revealed the following settings: output current of 1.75 mA, 30 seconds on, and 1.8 minutes off. CPAP therapy improved his oxygen saturations, but he continued to clinically exhibit the repetitive obstructive apneas even on positive pressure. However, after his VNS device settings were decreased, repeat polysomnography showed resolution of his obstructive breathing.

Conclusion: This case report demonstrates pediatric VNS-induced obstructive sleep apnea. Activation of the vagus nerve can cause laryngopharyngeal dysfunction, including laryngospasm and vocal cord dysfunction, with subsequent upper airway obstruction, causing obstructive apneas or hypopneas. Treatment options for pediatric VNS-induced OSA include CPAP, decreasing the VNS settings and adenotonsillectomy.
Support (if any):

845

PROGRESSIVE EXTERNAL OPHTHALMOPLEGIA IN SLEEP APNEA PRESENTING AS FLOPPY EYELID SYNDROME.

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Introduction: Floppy eye lid syndrome (FES) is known to be associated with Obstructive sleep apnea (OSA) and chronic progressive external ophthalmoplegia (CPEO) is a rare genetic disorder with mitochondrial myopathy that may present with isolated eye lid ptosis in the initial stages. In a patient with loud snoring and obesity, treating obstructive sleep apnea may improve Floppy eyelid syndrome.
Report of case(s): 52-year-old African – American male with past medical history of Hypertension, obesity, glaucoma, CPEO status bilateral blepharoplasty with failed surgical treatment. Patient was referred to Sleep medicine team to rule out Obstructive Sleep Apnea aa a cause of possible underlying FES and residual ptosis. On exam, patient was noted to have bilateral brow and eyelid ptosis and mild ataxic gait. MRI brain with and without contrast was unremarkable. Deltoid muscle biopsy was suggestive of possible congenital myopathy and mild denervation atrophy. Polysomnogram showed severe OSA with AHI of 74.1 per hour and patient was initiated on Auto CPAP at a pressure setting of 7–20 cm H2O. CPAP treatment improved snoring, OSA and subjective symptoms of excessive day time sleepiness but did not improve the residual ptosis.
Conclusion: Treatment of severe OSA in a patient previously diagnosed with CPEO and failed surgical treatment with bilateral blepharoplasty, did not alter the course of residual ptosis/ floppy eyelids even though his other sleep apnea symptoms have improved.
Support (if any): 1. McNab AA. Floppy eyelid syndrome and obstructive sleep apnea. Ophthalmic Plast Reconstr Surg. 1997 Jun;13(2):98–114. doi: 10.1097/00002341-199706000-00005. PMID: 9185193.

846

PULMONARY ARTERIAL HYPERTENSION AS A SEQUELA OF UNTREATED OBSTRUCTIVE SLEEP APNEA IN A PATIENT WITH PRADER-WILLI SYNDROME

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Introduction: Prader-Willi Syndrome (PWS) is a complex neurogenetic disorder characterized by hypotonia, behavioral problems, endocrinopathies, sleep and respiratory abnormalities. Morbidity and mortality in the PWS population is attributable to obesity, cardiovascular problems, and sleep apnea. We report a patient with PWS presenting with pulmonary arterial hypertension (PAH) due to untreated obstructive sleep apnea (OSA).
Report of case(s): Our patient is a 17-year-old female with a past medical history of PWS, scoliosis, obesity (BMI 52.46), hypogonadotropic hypogonadism, and type II diabetes. Baseline echocardiogram (ECHO) performed at age 9 revealed an estimated right ventricular systolic pressure (eRVSP) of 32mmHg above right atrial pressure (RAP), tricuspid regurgitation (TR) at 2.8 m/sec with no interventricular septal flattening (IVSF) and right ventricle (RV) systolic dysfunction suggestive of mild PAH. Given significant scoliosis the patient did not qualify for growth hormone therapy. She underwent a polysomnogram (PSG) at age 14 showing severe obstructive sleep apnea; apnea-hypopnea index (AHI) of 22.6 (oAHI 22.6). Patient was subsequently lost to follow up until presenting in acute respiratory failure at age 17. She required endotracheal intubation and was extubated to bilevel PAP (BPAP) with inability to wean off BPAP. At that time an ECHO revealed eRVSP of 55 mmHg above RAP, IVSF, TR at 3.7 m/sec, and RV systolic dysfunction suggestive of moderate to severe PAH and developing right sided heart failure. A PAP titration PSG during this admission revealed hypoxemia with oxygen saturation less than 90% (O2 nadir 70%) 12.6% of total sleep time (TST) and hypoventilation (transcutaneous CO2 max of 57 mmHg with an elevation above 50 mmHg for 100% of TST). Using an inspiratory PAP (IPAP) of 24 cmH2O and expiratory PAP (EPAP) of 14 cmH20 with supplemental O2 of 4LPM the respiratory events and hypoxemia resolved but there was persistence of hypoventilation. Tadalafil was initiated for PAH and BPAP therapy for OSA. Follow up visits 4- and 8-weeks post discharge shows improving PAH (TR 3.6 m/sec, eRSVP 52 mmHg, and mild IVSF) due to BPAP and tadalafil therapies.
Conclusion: This case highlights the importance of treating OSA in patients with PWS to prevent cardiorespiratory complications and reduce morbidity and mortality.
Support (if any): None

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RAPID IMPROVEMENT OF PULMONARY HYPERTENSION WITH ADEQUATE VENTILATORY SUPPORT IN PATIENT WITH PRADER-WILLI SYNDROME

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Introduction: Prader-Willi syndrome (PWS) is a genetic multi-system disorder characterized by developmental delay, hyperphagia, and often morbid obesity. Patients can have impairments in ventilatory control and are at risk for sleep disordered breathing due to craniofacial abnormalities, obesity, hypothalamic dysfunction, hypotonia and respiratory muscle weakness. This places them at higher risk for obstructive sleep apnea (OSA), hypoventilation and, if left untreated, may lead to cardiovascular complications. We present a patient with pulmonary hypertension (PH) in the setting of PWS and under supported OSA.
Report of case(s): A 17-year-old female with PWS, obesity, type II diabetes mellitus, developmental delay and severe OSA, non-adherent to positive airway pressure (PAP) therapy, presented with 6 months of pedal edema, weight gain with acute shortness of breath, fatigue, and decreased appetite. Upon arrival she developed hypoxemic, hypercapnic respiratory failure requiring intubation. Echocardiogram two months prior to admission showed normal right ventricular size and function with normal septal configuration. Echocardiogram after intubation showed signs of PH with dilated and hypokinetic ventricles compared to prior exam, worsening tricuspid valve regurgitation, and septal bowing. Sleep history was notable for severe OSA in 2017 with obstructive apnea-hypopnea index (oAHI) of 22.6, oxygen nadir of 74%, peak transcutaneous pCO2 of 51 mmHg. Patient was lost to follow-up and as per our history, was non-adherent to PAP therapy. On admission she was started

on aggressive diuresis and tadalafil. After successful extubation to BPAP and wean to room air while awake, a BPAP titration PSG was performed. It demonstrated low baseline oxygen saturations (93%), an oxygen nadir of 70%, transcutaneous CO2 peak of 57mmHg with obstructive events eliminated with BPAP of 24/14 cmH20 and hypoxemia treated with 4L supplemental oxygen. With adequate respiratory support with sleep combined with PH monotherapy, repeat echocardiogram prior to discharge showed improved systolic function and only mild septal flattening.

Conclusion: It is unclear the prevalence of PH in patients with PWS independent of OSA, however it is likely increased overall secondary to the increased prevalence of OSA. As a result, patients with PWS may benefit from routine interval echocardiogram to monitor for signs of PH.

Support (if any):

848

REFRACTORY HYPOVENTILATION IN CONGENITAL CENTRAL HYPOVENTILATION SYNDROME: A CASE FOR AVERAGE VOLUME-ASSURED PRESSURE SUPPORT

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Introduction: Congenital Central Hypoventilation Syndrome (CCHS) is a rare cause of alveolar hypoventilation in children resulting in lifelong ventilatory support. In older children requiring nocturnal support alone, the use of diaphragmatic pacing in conjunction with or independent of non-invasive ventilatory (NIV) support has been demonstrated to improve quality of life. We present a case of refractory hypoventilation despite escalation of NIV.

Report of case(s): 20-year-old female with Hirschsprung's disease and CCHS (20/26 polyalanine repeats) with history of invasive ventilation via tracheostomy who underwent bilateral diaphragmatic phrenic nerve stimulator placement at 13 years-of-age with subsequent tracheostomy decannulation. Diaphragmatic pacing was discontinued three years later in the setting of pneumonia and patient discomfort because of receiver positioning. At that time, she had improved subjective sleep quality and adequate ventilatory support on bi-level positive airway pressure (PAP) despite discontinuation of diaphragmatic pacing. Titration of bi-level PAP was done via polysomnogram four years later demonstrating nocturnal hypoventilation with transcutaneous CO2 values greater than 50 mmHg for 80% of the study and an oxygen nadir of 87% despite titration of inspiratory pressure and respiratory rate to maximize ventilatory assistance. The patient was subsequently admitted to the intensive care unit for transition to non-invasive average volume-assured pressure support (AVAPS) mode. Ventilation improved with nocturnal pCO2 values via capillary blood gas of 31 mmHg and 45 mmHg at 2 am and 6 am respectively. The patient was discharged on AVAPS therapy while undergoing evaluation to resume diaphragmatic pacing via cervical phrenic nerve stimulators for improved comfort.

Conclusion: Several ventilatory strategies may be employed in the care of patients with CCHS, with individualization of support based on phenotype, comorbidities, and patient and family preference. This case highlights the unique challenges of adequately ventilating patients as they age. The use of NIV via an AVAPS mode in patients with CCHS has been infrequently reported in the literature, though is promising in reported efficacy with regards to ensured ventilation. This, in conjunction with diaphragmatic pacing, may allow patients to achieve appropriate ventilation while maintaining quality of life, and could be considered in patients with refractory hypoventilation despite other modes of NIV.

Support (if any):

849

REM BEHAVIORAL DISORDER AS A PREDICTOR OF LEWY BODY DEMENTIA- A CASE REPORT

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Introduction: Dementia with Lewy bodies (DLB) is one of the most common types of degenerative dementia after Alzheimer's dementia. The core clinical features for diagnosis includes cognitive fluctuations, visual hallucinations, rapid eye movement (REM) sleep behavior disorder (RBD), and parkinsonism. Other symptoms include daytime drowsiness, longer daytime naps, prolonged staring spells, and episodes of disorganized speech. REM behavioral disorder (RBD) is commonly associated with DLB, occurring in 85 percent of individuals, often early in the course of the disease. It can precede the clinical diagnosis of DLB by up to 20 years.

Report of case(s): A seventy-six-year-old female with a history of well controlled obstructive sleep apnea was diagnosed with REM behavioral disorder in 2012. She had presented with episodes of screaming, attempt to ambulate during sleep, resulting in injury. Her polysomnogram revealed evidence of REM without atonia and a screaming episode during REM. Her RBD symptoms were controlled with clonazepam and melatonin with less frequency of the RBD episodes. The patient gradually started noticing memory issues and by January 2020 she was diagnosed with dementia and was initiated on Aricept. Within 7 months of diagnosis of dementia, she started reporting vivid hallucinations that were not threatening or violent compared to her violent content of RBD. Physical exam revealed impaired cognitive function and mild intermittent resting tremor of the right hand. The neurological exam was normal including normal tone, strength, and gait. She also reported repeated falls and fractures. The diagnosis of Lewy body dementia was made based on the presence of 2 core clinical features.

Conclusion: The current management of these conditions is mainly symptomatic. In the evolution of neurodegenerative disorder, RBD precedes other conditions like LBD, parkinsonism, etc. Research suggests that alpha-synuclein neurodegeneration is the common pathology behind these conditions. The understanding that RBD presents at the beginning of the evolution, provides us with a unique opportunity for preemptive treatment to prevent further degeneration in turn preventing the debilitation consequence like dementia, parkinsonism, neuroleptic sensitivity, and dysautonomia. Further research is needed for developing these early interventional strategies.

Support (if any): NOne

850

REM SLEEP AND ST DEVIATION IN ACUTE MYOCARDIAL INFARCTION

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Introduction: Sleep stage architecture and amount of REM sleep have been associated with mortality and clinical recovery, without clear etiology. Patients recovering from critical illness frequently experience

sleep disturbances, episodic arrhythmogenesis, EKG changes. This case aims to add to current field of study and describes an unusual pattern of sleep stage dependent, hypoxia independent, ST segment variation, which may benefit from further exploration and utilization of polysmongoraphy (PSG) in the immediate post acute MI period.
Report of case(s): 46 year old female with history of smoking, obesity, and diabetes presented for a sleep medicine evaluation, four days following a hospitalization for non ST elevation myocardial infarction (NSTEMI) and percutaneous coronary intervention. Her split night PSG data revealed severe obstructive sleep apnea (OSA) with apnea hypopnia index (AHI) of 131. Patient did not report acute cardiac symptoms during overnight sleep evaluation. On close observation of PSG data, the patient had grossly evident baseline ST segment depression during wake period. The ST depression persisted through stages 1 and 2 with unchanged morphology. During Stage 3, the ST segment showed progressive elevation to near the isoelectric line. During REM sleep without positive airway pressure (PAP), ST segment was noted at or near isoelectric line, even in the setting of hypoxia with saturation (Sao2) of 75%. During REM Sleep with PAP, the ST segment remained at the isoelectric line, and returning to baseline depression during wake phase while on BiPAP.
Conclusion: Residual ST segment deviation, and its resolution, are strong predictors of prognosis in patients with MI. Prior studies focused on hypoxic tolerance and sleep disordered breathing, with limited attention on specific sleep stage evaluation. REM sleep has been described as potentially having restorative effect on ischemic myocardium. Additionally, the transition period from non REM to REM sleep was reported to provide potential for myocardial restoration. PSG with cardiac monitoring remains a unique tool in further assessment of a possible association. This case aims to bring attention to the potential association of EKG ST segment variation with sleep stages, especially REM and S3, independent of hypoxia.
Support (if any):

851

SELF-MEDICATION WITH CAFFEINE FOR 31 YEARS: A CASE OF UNDIAGNOSED CHILDHOOD NARCOLEPSY TYPE II

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Introduction: Narcolepsy represents a relatively rare chronic neurological sleep disorder. While peak incidence occurs in adolescence and early-adulthood, reports indicate a substantial number of children under 10 remain undiagnosed or are misdiagnosed. The present case describes a female with undiagnosed narcolepsy type II self-medicating with caffeinated beverages from the age of 7.
Report of case(s): A 40-year-old female presented at our clinic with excessive daytime fatigue and hypersomnolence despite adequate sleep (Epworth sleepiness scale= 16/24). The patient denied snoring, sleep paralysis, catalepsy, and hypnagogic/hypnopompic hallucinations. Symptoms began at the age of 7 and steadily worsened, with teachers reporting significant concentration difficulties and multiple episodes of unintentional sleep onset in the classroom. The patient reported heavily relying on caffeinated beverages from the age of 7 to remain awake and focused on classroom activities. Starting at the age of 7, the patient consumed on average a caffeine-equivalent of 1 espresso shot/day (64mg caffeine/day). This increased to 4–6 espresso shots/day (256-384mg caffeine/day) by the age of 12 and 5–9 espresso shots/day (320-576mg caffeine/day) by the age of 18. At the age of 25, the patient developed severe anxiety with panic attacks and episodes of suicidal ideation. With multiple episodes of sleep onset while operating a motor vehicle, a near-accident prompted medical evaluation. Diagnosed with general anxiety disorder and idiopathic hypersomnolence, escitalopram and armodafinil were started with limited effect. The patient continued self-medicating with caffeinated beverages until age 38 when she was diagnosed with narcolepsy type II. Sodium oxybate was subsequently added to her treatment plan with initial sleep benefit and caffeine reduction. A repeat mean sleep latency test confirmed narcolepsy type II (mean sleep latency= 3 minutes, mean rapid eye movement [REM] sleep latency= 3 minutes). Polysomnography was later performed due to non-resolving symptoms, revealing mild obstructive sleep apnea (REM apnea-hypopnea index= 13.5/hour). Continuous positive airway pressure was added to the treatment regime with significant sleep benefit.
Conclusion: We describe a case of undiagnosed childhood narcolepsy type II necessitating significant caffeine consumptions in order to maintain classroom performance. With known anxiety-provoking effects of caffeine, the case highlights the importance of addressing childhood narcolepsy.
Support (if any):

852

SEVERE CENTRAL SLEEP APNEA IN A PATIENT WITH CORNELIA DE LANGE SYNDROME

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Introduction: Cornelia de Lange syndrome (CdLS) is a rare multisystem disorder with characteristic facial dysmorphisms, upper airway structural abnormalities, and varying degrees of intellectual and neurologic deficits. Affected patients can have many sleep problems including chronic insomnia and obstructive sleep apnea; however, there is no literature indicating central sleep apnea as a common sleep disorder in this patient population. We describe a patient with CdLS with an unusual presentation of both severe obstructive and central sleep apnea.
Report of case(s): The patient is a 12-year-old female with CdLS, global developmental delay, repaired bilateral cleft-palate, and oropharyngeal dysphagia. She was referred for diagnostic polysomnography for evaluation of snoring. Physical examination findings were significant for distinctive features of the head and face including microcephaly, micrognathia, and synophrys. Neurologically, the patient was non-verbal and wheelchair bound. Pre-evaluation screening indicated no concerns from the caregiver regarding problems with sleep initiation, maintenance, or daytime symptoms. Polysomnography (PSG) at age 7 years revealed severe obstructive and central sleep apnea with an apnea-hypopnea index (AHI) of 78.2/hr. The majority of these were central events (68.44/hr). There were no epileptiform foci recorded. Bilevel Positive Airway Pressure (BPAP) in Spontaneous/Timed (S/T) mode was titrated during the study which resolved all central events. Magnetic resonance imaging of the brain was obtained indicating mild hypoplasia of the corpus callosum. Since the initial PSG, 5 additional routine studies were conducted and progressive worsening of central sleep apnea was noted with the highest recorded AHI of 108.8/hr (central events: 81.4/hr). Apneic events were fairly managed with BPAP in ST mode.
Conclusion: Sleep-disordered breathing in CdLS is an increasingly diagnosed entity. While previous literature indicates airway obstruction as a common cause for sleep apnea in children with CdLS, our

case suggests that clinicians should consider central causes of sleep apnea in these patients. Given the sub-clinical progression of sleep apnea in this case study, routine follow up PSGs should be considered. Further research is necessary to increase knowledge of the incidence and management of central sleep apnea in children with CdLS.

Support (if any):

853

SEVERE OBSTRUCTIVE SLEEP APNEA AFTER TREATMENT WITH PHRENIC NERVE IMPLANT FOR CENTRAL SLEEP APNEA: A CASE FOR DUAL STIMULATION?

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Introduction: The remedē® system is a transvenous phrenic nerve stimulator used to treat central sleep apnea (CSA). It is a safe and effective implantable device that has demonstrated significant improvements in objective sleep and quality of life. While complex sleep apnea represents development of central sleep apnea during treatment with continuous positive airway pressure (CPAP) for obstructive sleep apnea, and has been well-described in the literature, we present a novel case of predominantly central sleep apnea treated with phrenic nerve stimulation with augmentation of obstructive events thereafter. This patient is, at the time of submission, being evaluated for hypoglossal nerve stimulation.

Report of case(s): A 63-year-old male patient with a past medical history of hypertension, atrial fibrillation, asthma, chronic obstructive pulmonary disease, GERD, obesity, and prior pulmonary embolism presented to the sleep medicine clinic with complaints of difficulty initiating and maintaining sleep, snoring, multiple nocturnal awakenings, excessive daytime sleepiness, and physical fatigue. On exam, BMI was 30.4, and airway classification was Mallampati 4. Split night polysomnography revealed severe mixed sleep apnea with an overall apnea hypopnea index (AHI) of 58.6 and a central AHI of 53.8 per hour after successful PAP titration at 7 cm H2O. He underwent phrenic nerve stimulator implantation and activation without complications. Phrenic nerve stimulation titration study four months after activation showed a normal central AHI of 4.6 per hour at a therapeutic voltage of 1.6 to 1.9mA, but significantly worse OSA with obstructive AHI of 53.1. In follow up, he reported intolerance of CPAP due to significant nasal congestion as well as asthma. Presently, he is scheduled for drug induced sleep endoscopy to visualize airway obstruction and is being evaluated for Inspire hypoglossal nerve stimulation and nasal surgery.

Conclusion: The treatment of sleep apnea has recently evolved rapidly with the development of implantable devices to treat both central and obstructive sleep apnea. We present a novel case of the first known patient to be considered for dual nerve stimulation for sleep apnea. Further study needs to be done to determine the safety and efficacy of concurrent implantable devices for the simultaneous treatment of OSA and CSA.

Support (if any):

854

SEXSOMNIA IN A DIVORCE PROCEEDING AND ITS CUSTODY IMPLICATIONS

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Introduction: Sexsomnia is a NREM parasomnia under the subtype of Confusional Arousals, defined as abnormal sexual behaviors emerging from partial arousals during slow-wave sleep. Case reports suggest that is more common in men. Precipitating factors include Obstructive Sleep Apnea, insufficient sleep, alcohol and fatigue/stress and history of NREM parasomnias.

Report of case(s): A 37-year-old male with bruxism (using mouth guard) and anxiety for 7 years, who presented to the sleep clinic for a second opinion to discuss concerns around the safety of his children due to his sleep related sexual behavior. Sexsomnia was first noted with the stressors related to becoming a parent (fostering children and having biological children). Sexual behavior reported by the couple was mostly provoked with spouse's touch during sleep. Behaviors ranging from fondling to aggressive sexual intercourse were reported to occur 1 to 3 times/week. There were no injuries during episodes which only occurred in the bedroom with the spouse and the patient was amnestic of his behavior. Due to marital discord provoked by other stressors, he began to sleep alone in the basement. A video-polysomnogram revealed no parasomnia, sleep apnea, or other sleep arousal disorders. Normal REM with atonia was observed. The patient was treated with Duloxetine 20mg for anxiety after the initial sleep visit. His condition contributed to marital separation. In the divorce proceedings, the spouse argued for denial of visitation rights related to his sleep-sexual behaviors noting that the children may be at risk. After separation, his anxiety and stress levels lowered in conjunction with therapy and medication. Follow up after 2 months found the patient asymptomatic. He placed an alarm on his bedroom door, to alert him and others during sleep. There are no published reports to provide a prediction as to whether his condition would-be supporting restrictions in overnight visitation by the foster and biological children.

Conclusion: In this case, there was a precedent condition (bruxism) and precipitating stress and anxiety, known to provoke NREM parasomnia. The absence of polysomnographic evidence is not unusual. Forensic repercussions, in particular prospective calculations of risk, are poorly described in the literature.

Support (if any):

855

SEXSOMNIA: A CASE SERIES LOOKING AT A RARE PARASOMNIA

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Introduction: Sexsomnia is a male predominant, rare subset of NREM parasomnia involving sleep-related sexual activity. Symptoms can range from individual sexual acts, such as masturbation, to acts involving bed partners, often without recollection. Sexsomnia results in profound personal, social, and legal ramifications. Though typically treated with benzodiazepines, here we present three patients that were managed nontraditionally.

Report of case(s): Case 1 A 34-year-old man with a history of optimized obstructive sleep apnea (OSA), alcohol abuse, and bipolar disorder reported eight-years of parasomnia characterized by fondling, sexual intercourse, and aggressive sexual acts, despite treatment with benzodiazepines. His fiancé noted that his advances when sleeping were atypical for their normal intimate interactions. He was observed to have frequent arousals from N3 sleep during PSG. The patient denied current substance use, but did report bilateral foot discomfort leading to sleep disturbance. His ferritin was 38 ng/mL, and he was started on oral iron and vitamin C. Case 2 A 41-year-old woman with a history of anxiety, psoriatic arthritis, insomnia and childhood somnambulism presented with parasomnia ranging from fondling to sexual intercourse. Her husband noted

that during the episodes, her mannerisms and speech pattern were vastly different from normal. She endorsed difficulty initiating sleep, with a sleep latency of one hour and frequent arousals despite using trazodone nightly. She consumed two to five glasses of whiskey in the evenings several nights a week. Parasomnia events were more prevalent on nights that she partook in alcohol and improved with alcohol cessation. Case 3 A 44-year-old man with a history of optimized mild OSA presented with parasomnias characterized by somnambulism with goal-directed behavior and sexual activity, with a family history of violent parasomnias. Given the atypical nature of his events, he was referred to the epilepsy monitoring unit, which was ultimately nondiagnostic. Benzodiazepine therapy was ineffective. He chose to defer further medical management, leading the patient to pursue cognitive behavioral therapy, with moderate benefit. He reports infrequent parasomnias off medications.
Conclusion: Sexsomnia remains a rare, and likely under reported phenomenon. In each of the highlighted cases, the patients responded to treatment without the use of standard benzodiazepine therapy.
Support (if any):

856
SLEEP-WRITING, SLEEP-TALKING IN UNCONTROLLED REM-PREDOMINANT OBSTRUCTIVE SLEEP APNEA
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Introduction: Abnormal movements and behaviors during sleep are part of a larger group of nocturnal events that may occur during the sleep-wake cycle and/or the transitions into and out of sleep. We are presenting the case of OSA-related confusional arousals associated with sleep-writing and sleep-talking during REM-sleep.
Report of case(s): 46 year old female with history of CAD, HTN, RLS, Anxiety, Depression, and REM predominant OSA (AHI of 2.9 per hour of sleep, REM AHI of 40 per hour of sleep, and oxygen saturation nadir of 91%), noncompliant with PAP therapy, returned to reestablish sleep medicine care and restart PAP therapy. The patient reported worsening of her OSA symptoms while being without PAP therapy. In addition to traditional OSA symptoms (snoring, frequent nighttime awakenings, restless legs, daytime sleepiness/fatigue), she reported episodes of sleep-talking, sleep-writing with demonstrated evidence of these events in her personal diary. She maintains a collective diary that incorporates her blood pressure readings, her weight loss accounts with records of meals in a day, as well as a separate log of letters that she will write and mail. In this diary, she has noticed sleep writing instances in each field, with no recollections subsequently on the act of writing them. The patient reported that these episodes of sleep writing would occur 3–4 times in a week, during this period of PAP noncompliance. Last reported instance of her sleep writing was October 2020. After re-initiation of PAP therapy, the patient has not reported further episodes of sleep-writing or sleep-talking.
Conclusion: The sleep-writing is a very rare clinical symptom in the presentation of REM-predominant OSA as well as in REM/NREM parasomnias. We were not able to come across a case of it in the sleep literature review. Sleep-talking is a well-documented phenomenon. Confusional arousals may be responsible for symptoms of sleep-writing and sleep-talking in this case. We may repeat a sleep study with split protocol and parasomnia montage using AutoBipap if needed to investigate further. Further research should be done to explore the nature and correlation of sleep-writing in clinical practice.
Support (if any): N/A

857
TOO SLEEPY: A PEDIATRIC CASE OF PRADER WILLI SYNDROME AND NARCOLEPSY
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Introduction: Prader Willi syndrome (PWS) is a genetic disorder due to deletion of the paternal copies of genes within the chromosome region 15q11-q13. Individuals with PWS are commonly seen with obesity, sleep disordered breathing, and excessive daytime sleepiness (EDS). While the exact cause of EDS in individuals with PWS is not fully understood, there have been reports of PWS with narcolepsy-like syndrome. We report a case of a patient with PWS with findings suggesting the diagnosis of Narcolepsy Type 2.
Report of case(s): Our patient is a 12-year-old male with PWS and 2nd degree heart block who was evaluated in our pediatric sleep center. He has a previous diagnosis of mild obstructive sleep apnea (OSA) with an apnea hypopnea index (oAHI) of 3.2. At 12 years of age, mother and patient reported that he had increased snoring, weight gain, EDS with a Pediatric Daytime Sleepiness Score (PDSS) of 10 and frequent refreshing naps during the daytime. Patient denied cataplexy during that visit. Subsequently, 2-week actigrapghy was performed which demonstrated an average total night sleep of 8 hours and 8 minutes. Overnight PSG with Multiple Sleep Latency Test (MSLT) demonstrated an oAHI of 4.8, total sleep time of 6.88 hours. During the MSLT, the mean sleep latency was 6.2 minutes and 5 sleep onset REM periods were observed over 5 nap opportunities. At his follow-up visit, methylphenidate was initiated after clearance by his cardiologist. Patient and mother opted for medical management of his mild OSA with Fluticisone and Montelukast. At his follow-up appointment, the patient had improvement in daytime sleepiness with a PDSS of 2 despite taking his Methylphenidate at night. Patient was instructed to switch to morning Methylphenidate dosing to optimize treatment of his EDS.
Conclusion: EDS is a common complaint seen in patients with PWS, however the etiology of it is not entirely understood. It is thought to be centrally mediated with components of hypersomnia and narcolepsy like-symptoms. More research is needed to better understand, diagnose and adequately treat patients with PWS and EDS.
Support (if any):

858
TRANSITIONS TO VIRTUAL ADMINISTRATION OF CBT-I: STRENGTHS & BARRIERS
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Introduction: In March 2020, the University of Arkansas Psychological Clinic began social distancing resulting in a CBT-I group (four patients, 3 trainee co-leaders) transitioning from in-person meetings to telehealth via Webex. Two co-leaders led the group while the third disseminated electronic materials and scored the patients' online sleep diaries. Virtual administration of CBT-I had benefits and challenges.
Report of case(s): Firstly, many of the patients were familiar with teleconferencing as their jobs also transitioned to virtual meetings and could identify environments with limited interruptions. Telehealth group etiquette such as muting audio, timely diary submission, and peer support were easily mastered. However, one patient had poor internet connection, which necessitated switching between their laptop and phone to connect and seemed to negatively impact engagement

with the group. Furthermore, the clinicians were confronted with the difficult decision to continue helping troubleshoot technical issues or continue with the session. During in-person visits, co-leaders could address difficulties with sleep prescription or questions about the material; however, balancing technical issues, answering questions, and facilitating support amongst the patients via telehealth was often distracting and inefficient. From a clinician perspective, it was difficult to co-lead the group due to patients respectfully muting their mics, resulting in less contributions to discussion. Additionally, many of the administrative tasks typically completed with clinic staff after an in-person session were completed during session, making it challenging to maintain confidentiality. Presentation of visual aids was difficult as patient using cellphones to connect could not view and download files while connected to session. Finally, basic clinical techniques were impacted using the virtual platform. For instance, "sitting in silence" was less effective while maintaining eye contact with the entire group was facilitated by looking directly at the camera. Unfortunately, reading facial expressions and non-verbals was often more difficult and clinicians relied on more direct questions rather than open-ended questions.

Conclusion: These challenges provide opportunities to learn how to make CBT-I via telehealth more effective. Despite the challenges of transitioning to telepsychology, the CBT-I group was effective as evidenced by high satisfaction ratings from patients, reductions in PHQ-9 and ISI scores, SOL, WASO, and increases in sleep efficiency.

Support (if any):

859

TRIAL OF AVERAGE VOLUME-ASSURED PRESSURE SUPPORT (AVAPS) TO TREAT HYPOVENTILATION IN A CHILD WITH RAPID-ONSET OBESITY WITH HYPOTHALAMIC DYSFUNCTION, HYPOVENTILATION, AND AUTONOMIC DYSREGULATION (ROHHAD) AND SYSTOLIC HEART FAILURE

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Introduction: ROHHAD syndrome is a rare disorder of respiratory control and autonomic nervous system regulation with endocrine abnormalities. Although children may present with obstructive sleep apnea, their blunted respond to hypoxemia and hypercapnia is a life-threating feature, often leading to cardiorespiratory arrest. There is limited literature regarding non-invasive positive pressure ventilation (NIPPV) in these children. We report a trial of AVAPS in a child with ROHHAD syndrome.

Report of case(s): Our patient is a 6-year-old male with history of rapid weight-gain (49.9 kg in 2.5 years), type-2 diabetes, and mild OSA who presented to an outside hospital (OSH) in March 2020 with acute hypercapnic hypoxemic respiratory failure. He required bilevel PAP therapy, steroids, and bromocriptine for thermoregulatory dysfunction. His clinical presentation, along with negative PHOX2B gene mutation and absence of parenchymal lung disease on chest computerized tomography suggested a diagnosis of ROHHAD syndrome. Outpatient, he was successfully transitioned to empiric AVAPS therapy. In November 2020, he presented again to an OSH in hypercapnic hypoxemic respiratory failure with new systolic heart failure with ejection fraction of 28%. After clinical stabilization, he was transferred to our hospital on CPAP 10 cmH20 with 100% FiO2 for further management. Awake blood gas was consistent with chronic hypercapnic respiratory failure; therefore, the patient was placed initially on bilevel PAP therapy empirically until an inpatient bilevel PAP titration polysomnogram was conducted. The patient remained hypercapnic and was converted to continuous AVAPS therapy starting at a tidal volume of 8.6mL/kg based on ideal body weight. AVAPS was titrated until achieving adequate ventilation, but the patient was unable to tolerate continuous NIPPV. Because of his heart failure in the setting of expected worsening respiratory failure, the decision was made to pursue tracheostomy placement for invasive positive pressure ventilation.

Conclusion: ROHHAD syndrome is a rare disorder that begins within the first decade of life, making adherence to daytime NIPPV difficult. This case illustrates a trial of AVAPS in a child with ROHHAD syndrome prior to tracheostomy placement. It highlights the need for future research in advanced ventilatory support strategies in children.

Support (if any):

860

VARIABLE SLEEP APNEA SYNDROMES COMPLICATED BY NEUROSURGERIES IN A PATIENT WITH CHIARI MALFORMATION TYPE 1

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[1]Thomas Jefferson University

Introduction: Chiari malformations (CM) are congenital conditions defined by craniocervical junction anatomic anomalies with downward displacement of cerebellar structures. Sleep-disordered breathing (SDB) including obstructive sleep apnea (OSA), bradypnea, central sleep apnea (CSA), and hypoventilation are described in CM patients.

Report of case(s): 31-year-old male with history of CM type 1 presented to the sleep medicine clinic for management of OSA and CSA diagnosed at age 16. PSG showed an apnea-hypopnea index (AHI) of 14.2, RDI of 29, and no central events. He was started on auto-CPAP with pressures of 5–20 with subsequent visits showing high residual AHI. A subsequent CPAP-titration study resulted in a pressure of 16cm H2O yielding AHI of 0. CPAP pressure was fixed, but a high residual AHI persisted despite excellent compliance. A split-night study resulted in a BiPAP prescription, for which a titration study noted PAP-emergent CSA. He was started on auto Bilevel with IPAP of 30, EPAP of 8 and backup rate of 12bpm. Despite treatment, elevated AHI persisted so he was switched to adaptive servo-ventilation (ASV) with nightly oxygen blended in resulting in controlled complex sleep apnea. SDB management was complicated by multiple neurosurgical decompressions. During the most recent procedure, he was found to have syringomyelia, syringobulbia, and a mass at the brainstem. Surgery, including placement of a 4th ventricle stent and mass excision, initially led to a decrease of residual AHI to a low of 0.7, before progressively increasing to 15. A repeat PSG demonstrated severe OSA (AHI of 35), without evidence of CSA or nocturnal hypoventilation. ASV was resumed and patient's AHI progressively decreased to an average of 8, with improvement in his sleep apnea symptoms.

Conclusion: SDM in CM patients can be explained by condition-related anatomical changes and depression of respiratory centers due to possible extrinsic compression leading to complex sleep apnea presentations. While it is unclear why this patient's sleep apnea improved then worsened after his latest decompression surgery, we believe that CSF recirculation and postoperative inflammation may be responsible. Close monitoring of SDB in patients with CM is important as they may require advanced therapies for proper control.

Support (if any):

861

VASCULAR DEMENTIA PRESENTING AS RAPIDLY PROGRESSIVE DEMENTIA SECONDARY TO ZOLPIDEM

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Introduction: Rapidly progressive dementia is a condition with a wide differential which remains difficult to accurately diagnose. The potential pathologies responsible include thyroid, vitamin, and electrolytes abnormalities, infectious, and malignant causes. Vascular dementia, however, typically has a slow and insidious presentation. Zolpidem (Ambien) is among the top 50 prescribed medications in the US.
Report of case(s): An 84-year-old Caucasian male with a past medical history of insomnia, and sleep apnea who is noncompliant with CPAP presented after a fall associated with altered mental status. He has taken zolpidem 10 mg nightly for over six years. The patient and wife reported notable personality changes beginning six months prior, as well as four months of progressively worsening auditory and visual hallucinations. Additionally, the patient noted developing urinary incontinence, and worsening gait steadiness with recurrent falls. The patient then developed sleep-wake inversion during the three weeks prior to his fall, and an outpatient referral to neurology was subsequently sent for dementia evaluation. On the night prior to his presentation, the patient took his usual nighttime zolpidem at 22:00 and later fell and was unable to get up. Subsequent testing was negative for reversible causes of dementia and MRI Brain revealed only chronic microvascular disease. His zolpidem dose was decreased to 5 mg and scheduled earlier which resulted in the resolution of his hallucinations, gait abnormalities, and acute encephalopathy.
Conclusion: One month later, the patient presented to the hospital after a repeat fall secondary to taking his zolpidem at his previously scheduled time. Once more, his dosage was further decreased to 2.5 mg and scheduling earlier, resulting again, in the complete resolution of his symptoms. Zolpidem, has an increased potential for delirium in elderly patients and especially those with dementia. Chronic use of zolpidem with insidiously progressive vascular dementia led to a worsening delirium which resolved after adjustment of timing and reduction of zolpidem dosing.
Support (if any):

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VOLUME-ASSURED PRESSURE SUPPORT IMPROVES OUTCOMES IN A PATIENT WITH CONGENITAL CENTRAL HYPOVENTILATION SYNDROME

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Introduction: Congenital Central Hypoventilation Syndrome (CCHS) is a condition caused by a mutation of the PHOX2B gene and an incidence of 1 in 50,000 live births. Clinically the condition is characterized by autonomic nervous system dysfunction, the most prominent feature of which is the failure of respiratory homeostasis during sleep. In patients severely affected, life-long ventilatory support is required. This might start as early as the newborn period. Subsequent adjustments are required due to their growth and development. The role of Volume-Assured Pressure Support (VAPS) ventilation in treatment of CCHS was only described in a couple reports before.
Report of case(s): A 17-year-old female patient born at term and diagnosed with CCHS at birth at our center with a PHOX2B mutation confirmed. Her daytime ventilatory support was weaned at age 18 months and the tracheostomy was removed at age 10 years old. She relocated to another state, was lost to follow-up, and returned this year for adjustments of her ventilator whose settings had not been adjusted for several years. She was on a Trilogy 100 ventilator, in pressure-controlled mode with settings of EPAP 5, IPAP 20, and a rate of 22/min without supplemental oxygen. Her measured weight is 69kg, body mass index (BMI) 27. The patient complained of difficulty breathing while on those settings and reported decreased desire to use the machine. The patient was empirically switched to VAPS due to titration availability limitations during the COVID-19 pandemic. Initial AVAPS settings were: EPAP 4–7, PS 3–12, breath rate 16/min, TV 350mL. Upon implementing the changes, the patient reported improved comfort and increased usage. Average minute ventilation decreased from 10.5 to 5.8 L/min, patient triggered breaths increased from 1.1% to 12.3%, average breaths per minute decreased from 22.0/min to 16.2/min, the average peak flow 31.8 to 26.2L/min, tidal volume decreased from 463 to 355mL.
Conclusion: AVAPS ventilation can be successfully used in managing patients with CCHS, and it might be superior to pressure-controlled mode in certain cases, improving patient comfort and compliance.
Support (if any): Department of Internal Medicine, University of New Mexico School of Medicine, Albuquerque, NM.

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WHEN SLEEP TAKES YOU TO UNWANTED PLACES?

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Introduction: Somnambulism is a parasomnia occurring in non-rapid eye movement sleep, and is characterized by ambulation as a disorder of arousal regulation. Sleep deprivation, alcohol abuse, fragmented sleep and certain medications can increase the risk of sleep walking.
Report of case(s): Here we present a 35-year-old man with multiple triggers for sleep walking, resulting in recurrent parasomnia events over fifteen years. He had a history of bipolar disorder, post-traumatic stress disorder (PTSD), chronic insomnia, moderate untreated obstructive sleep apnea (OSA), anxiety with violent daytime behaviors, and prior alcohol abuse status post six years of sobriety. He was sent to our clinic due to increased frequency and severity of events, with nightly events for the last five years. Episodes were characterized by walking around the home, leaving the home, and driving on occasion. He reported at least one minor car accident as a result of sleep driving. He also reported an injury resulting from a fall in his home while sleep walking. Several security measures were implemented, including door gates, door alarms, and hiding car keys. His family slept in different bedrooms with locked doors for safety. The patient's chronic insomnia improved with cognitive behavioral therapy, leading to an average sleep time of five hours per night with no reported hypersomnia or daytime fatigue. After his initial evaluation, he was referred for a mandibular advancement device for treatment of his OSA, due to prior poor compliance with positive airway pressure therapy related to his PTSD. Optimizing his OSA helped decrease arousals that might trigger sleep walking events. He also maintained close follow up with mental health for pharmacotherapy and psychological therapy. Treatment with clonazepam 0.25 mg at bedtime was initiated given the severity of his somnambulism.
Conclusion: The use of a benzodiazepine can reduce slow wave sleep duration by its effect on the inhibitory neurotransmitter gamma aminobutyric acid (GABA). Our patient had multiple risk factors for parasomnias, with severe, frequent episodes of sleepwalking leading to self-injury. His treatment involved both pharmacotherapy as well as optimization of underlying triggers.
Support (if any):

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NEW-ONSET OBSTRUCTIVE SLEEP APNEA DIAGNOSIS IN A COVID-POSITIVE PATIENT

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Introduction: Risk factors for the mortality of COVID-19, such as cardiovascular and lung disease, are commonly seen in patients with obstructive sleep apnea (OSA). Patients with OSA experience approximately 8-fold greater risk for COVID-19 infection compared to a similar age population. Among patients with COVID-19 infection, OSA was associated with an increased risk of hospitalization and approximately doubled the risk of developing respiratory failure. However, there is little information on whether COVID-19 can directly develop OSA. To the best of our knowledge, we describe the first case-presentation of a positive COVID-19 patient who developed sudden-onset OSA.

Report of case(s): NL is a 47-year-old female who complains of new-onset snoring, excessive daytime sleepiness, and witnessed apnea events after testing positive for COVID-19 seven months prior after developing mild symptoms. Her ESS score is 12/24, neck circumference is 14.75 cm, BMI is 27.9, and Mallampati II. She has no pertinent PMH and is not a tobacco user. In regards to her sleep, she has no symptoms of restless legs, narcolepsy, or periodic limb movements. She denies any physical disturbances, psychiatric conditions, environmental factors, or medical issues that might affect her sleep. There is no family history of sleep apnea, snoring, or other sleeping disorders. The patient's presentation at the initial sleep visit prompted a home sleep study. Results of her home sleep study revealed 131 total number of sleep-related respiratory events, with an apnea-hypopnea index of 11.9 per hour. Mean oxygen saturation was 94% and the minimum oxygen saturation was 83%. Total estimated sleep time was 7 hours, 59 mins, and sleep quality and duration were deemed adequate. The results from NL's sleep study gave the final diagnosis of mild OSA.

Conclusion: Besides having a slightly overweight BMI, NL had relatively few risk factors for developing OSA (no family history, no comorbidities, and normal physical exam findings). The link between the virus and the development of OSA in healthy individuals is not readily apparent. We recommend sleep studies for healthy patients who develop OSA like-symptoms after being infected with COVID-19 to prevent unwanted health risks associated with OSA.

Support (if any):

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